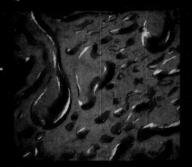
February 10, 1958 Published every-other-Monday Seventy-five cents



# NEW "LAZY TOWER"

Horizontal still can fractionate...

- · Heat-sensitive materials
- · At high vacuum
- · With low pressure drop



LAZY" MEANS "HORIZONTAL"
CORROSION CONTOURS AID MAINTENANCE
HOW TO START STANDARDIZING

PAGE TWO



## FEBRUARY 10, 1958

JOHN R. CALLAHAM, Editor-in-Chief

#### As Professional Men . . .

As engineers and as specialists in the fields of their coverage, CE editors are members or attend meetings of 71 technical and industry organizations in the fields of engineering and the chemical process industries.

 $\triangleright$  27 + 44 = 71: To illustrate, CE

editors:

· Are dues-paying members of 26 engineering, technical and industry organizations.

· Hold office, serve on committees or otherwise participate actively in the affairs of 13 of these groups.

· Attend regularly the meetings and conventions of 27 organ-

izations.

· Cover meetings of specific interest to our fields of an addi-

tional 44 organizations.

▶  $16 \div 19 = 0.84$ : Of the 19 engineer-editors on CE's staff, 16 are members of AIChE (11 national, 5 local). This 84% membership isn't surprising, since most of our editors are chemical engineers. We also have two mechanical engineers, members of ASME.

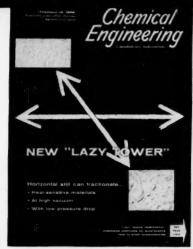
A few more of the 26 groups with one or more dues-paying CE

member:

Air Pollution Control Association, American Association of Cost Engineers, American Ceramic Society, American Chemical Society, American Nuclear Society, American Petroleum Institute, Electrochemical Society, National Association of Corrosion Engineers, Society of Chemical Industry, Technical Association of Pulp and Paper Industry.

CE editors have held, at one time or another, a top or near-top position in virtually every leading organization in our field.

We believe in becoming actively associated with the industries and professional people we serve.



THIRD OF TWENTY-SIX ISSUES



#### GUIDED TOUR



#### Sidewise attack beats old fractionating problems lying down

All the packing, plates, risers and bubble caps are gone from this "lazy tower." New horizontal approach to differential distillation takes a lot of pressure drop out of highvacuum fractionating. Tested on tall oil, it's a proved way to process, purify and recover many heat-sensitive organics and petrochemicals. (p. 77)



#### New jab at atmospheric corrosion

Corrosion contour maps of plant areas can help find your danger spots. They're already serving as part of one of today's highly successful maintenance and painting programs. (p. 125)



#### Very low and very high

Here's a speedy way to calculate stage requirements 'way at the ends of distilla-

# Chemical

# GUIDED TOUR

tion diagrams where concentrations are very high or very low. Today's emphasis on purity makes it important. (p. 129)



#### For fast relief

Spring-loaded relief valves on your equipment protect it against over-pressure. But here are the facts and formulas for picking the right ones for various conditions in your processing. (p. 133)



#### A real standardization program

One five-year-old standardization program is now paying off. So-called programs of 20 or more years ago are quaint and expensive. Now's the time to learn what really can be accomplished. (p. 141)



#### Another gap in thermal data now filled

There's now one less "lack." New pressure-enthalpy diagrams—in usable form—have been made for hydrochloric acid and chlorine. Vital to designers with problems in compression and condensation. (p. 144)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order this issue:

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February 10, 1958—CHEMICAL ENGINEERING



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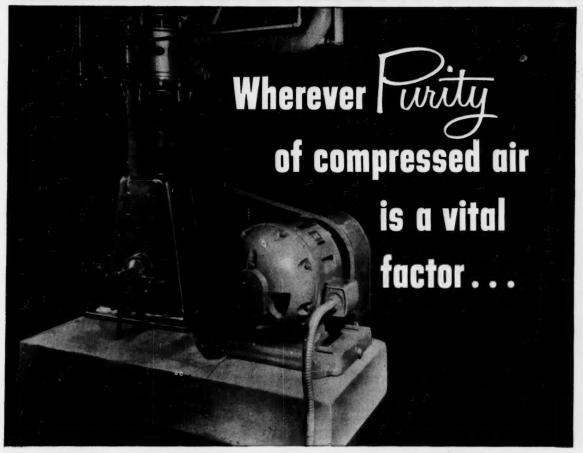
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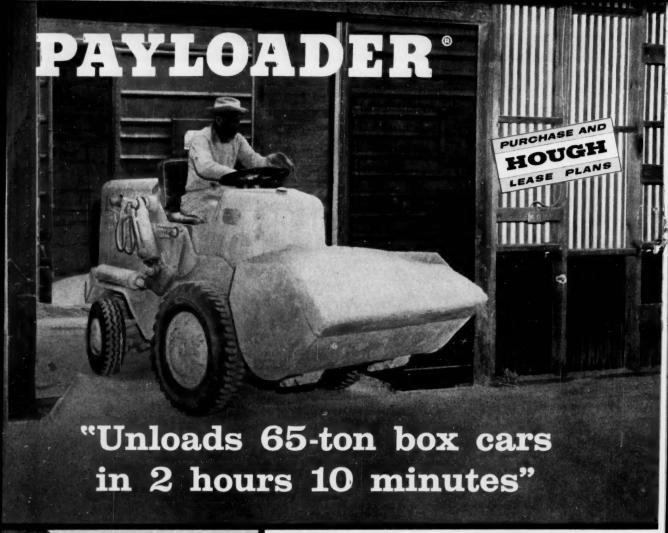








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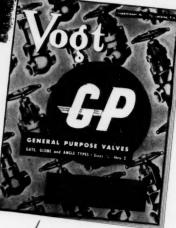
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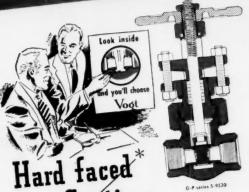
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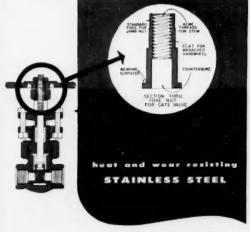
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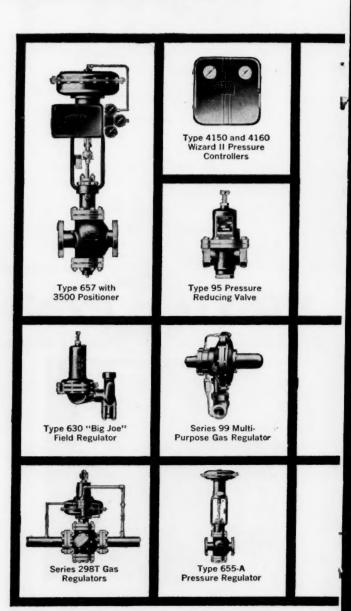
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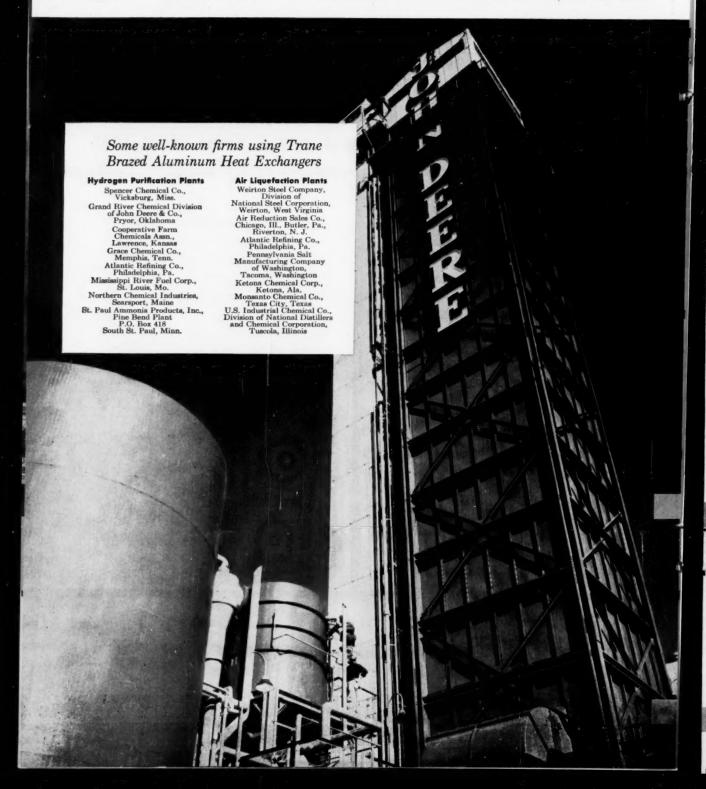


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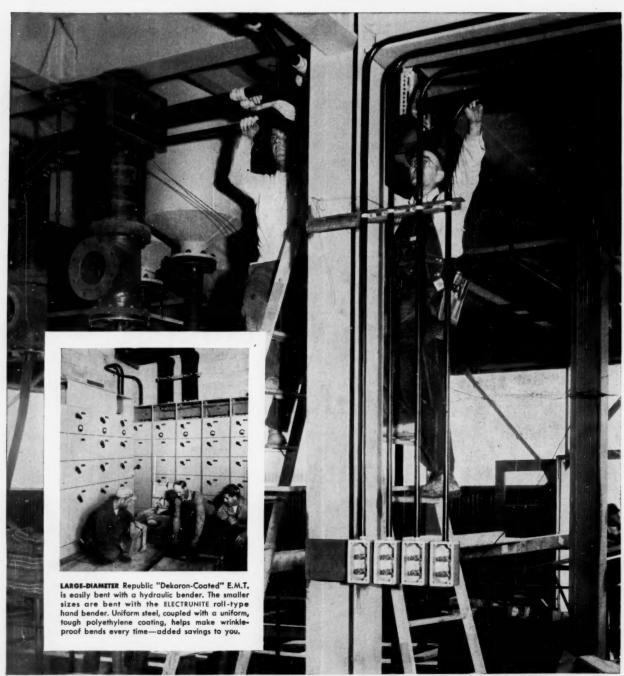
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- · for vacuum service and pressures to 5,000 pounds
- one to four stages of compression
- · built-in motor, coupled or belt drive

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simple · compact
long life · low upkeep
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Owner: U. S. Industrial Chemicals, Inc., Tuscola, Illinois — Phosphor-Acid Plant, Electrical Contractor: Harrison Blades, Decatur, Illinois.

# REPUBLIC





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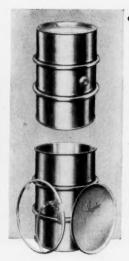
—Protects Circuits from Moisture, Fire and Mechanical Damage

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# STEEL

and Steel Products

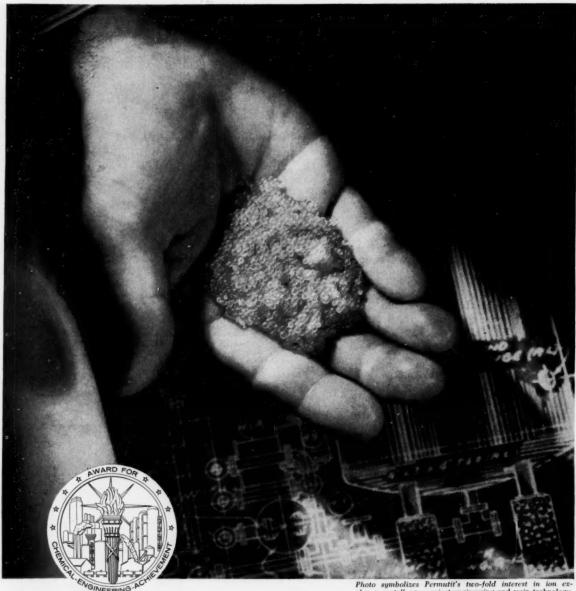
# REPUBLIC STEEL CORPORATION DEPT. C-3948-A 3116 EAST 45th STREET • CLEVELAND 27, OHIO Please send more information on: "Dekoron®-Coated" E.M.T.

☐ "Dekoron®-Coated" E.M.T.
☐ Stainless Steel Barrels and Drums
☐ ENDURO® Stainless Steel

Name\_\_\_\_\_Title\_\_\_\_

Company\_\_\_\_

Address\_\_\_\_\_\_State\_\_\_\_\_State\_\_\_\_



## Photo symbolizes Permutit's two-fold interest in ion ex-change metallurgy: project engineering and resin technology

# Pioneering in ion exchange metallurgy

• The first five ion exchange plants. for extracting uranium on a production basis were designed by Permutit engineers. The first of these has been producing uranium since October, 1952. All of these pioneer ion exchange plants-and many other large Permutit-designed installations in South Africa, Belgian Congo and Canada-are producing at high efficiency.

Six out of seven of the top-producing U. S. uranium mills using the

resin-in-pulp process now depend on Permutit SKB ion exchange resin. Permutit SKB provides high uranium capacity and efficient recovery under production conditions. It was developed by Permutit resin research especially for uranium extraction.

This record shows that Permutit is in ion exchange metallurgy "with both feet" . . . in both process engineering and resin chemistry. And Permutit's research program in this

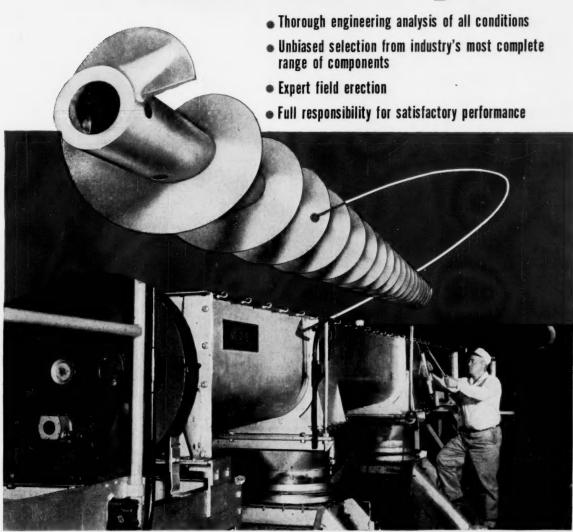
field promises important new developments on both fronts.

The Permutit Company, Dept CE-2, 50 West 44th St., New York 36, N. Y. and Permutit Company of Canada Ltd., Toronto 1, Ontario.

a division of PFAUDLER PERMUTIT INC.

Water Conditioning Ion Exchange . Industrial Waste Treatment Here's why a Link-Belt engineered screw conveyor installation means

# a better-working system ... less work for you



 $F_{
m ing}$  design of equipment to operation, you leave nothing to chance when you leave everything to Link-Belt's complete screw conveyor service. Whatever your needs, Link-Belt can engineer a system to meet them exactly . . . if desired, will handle entire erection and accept full responsibility for placing your system in operation.

Included in Link-Belt's full line of components are 17 basic screw designs, available in a variety of metals. Each offers Link-Belt's exclusive Quik-Link feature that permits fast, easy removal of any conveyor screw section or hanger without disturbing other components. An equally complete line of troughs, ball and babbitted bearing hangers, trough ends with ball bearing flange blocks and trough end seals, couplings, gates, spouts, and drives makes Link-Belt your

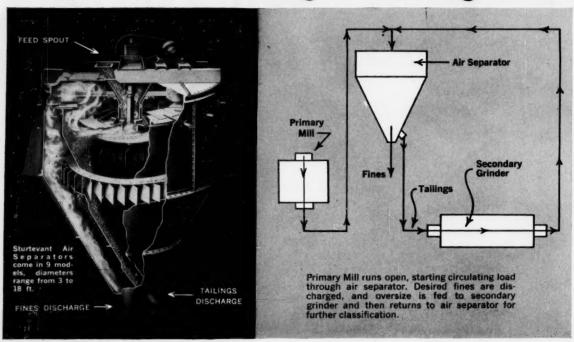
convenient, one-source supplier for all your requirements. Ask your nearest Link-Belt office for Data Book 2289.



SCREW CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7: Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

# Stop Overworking Grinding Mills



# PRODUCE UP TO 300% MORE 40 TO 400 MESH FINES — CUT POWER COSTS AS MUCH AS 50%

Fines that pass through grinding mills unhindered, serving only to increase the work load, can be quickly classified by a Sturtevant Air Separator operating in closed circuit. With all oversize automatically returned for further grinding, the result is production capacity impossible to achieve in single-pass grinding — as well as a better, more uniform product.

Closed circuit grinding and air separation is of proved advantage in all secondary reduction processes. Grinding mills are free to perform at top efficiency, their output frequently increased as much as 300% and power costs cut up to 50% (documented by 30 years of Sturtevant air separation experience in the cement industry). Further, attritional heat is dissipated by greater surface exposure.

#### Sturtevant Air Separators Keep Grinding Units At Peak Efficiency — Classify Feed Loads to 800 Tons Per Hour

Sturtevant Air Separators circulate production loads with exact control of air currents and centrifugal force. Simple adjustments make possible counter-action between the two to the point where a product of almost any desired fineness may be collected while coarser sizes are rejected.

A 16 ft. Sturtevant, for example, took a feed rate of 800 tph, containing only a small percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculat-

ing the oversize through the grinding circuit. (In the cement industry, Sturtevant units deliver up to 60 tph raw cement fines, 40 tph finished cement fines.)

Sturtevant's ability to engineer precise, high capacity classification for closed circuit grinding systems is the result of long experience with a wide variety of dry processes. Sturtevant designed its first air separator some 40 years ago — and has been pioneering developments in centrifugal classification ever since.

Current users of Sturtevant Air Separators include manufacturers of sulfur, soybeans, phosphate, chocolate, feldspar, sand, pigments, limestone fillers, abrasives, plasters, ceramics and cement.

Designed for precise separation of all granular materials, Sturtevant Air Separators have been adapted to other materials as well. Johns Manville, for example, uses a 10 ft. model to separate 3 to 6% undesirable rock from asbestos.

Ruggedly constructed, Sturtevant units are designed for minimum maintenance — at a Midwestern rock-crushing plant, a 10 ft. Separator operates outdoors year-round with only routine care.

For further information, request Sturtevant Bulletin No. 087. Write Sturtevant Mill Co., 100 Clayton St., Boston 22, Mass.

# STURTEVANT

**Dry Processing Equipment** 

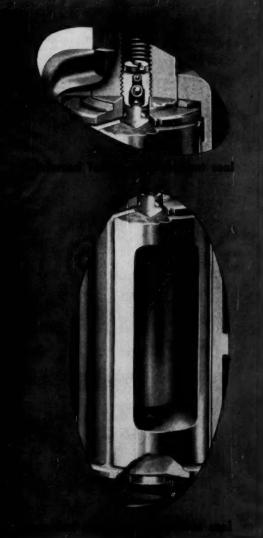
CRUSHERS • GRINDERS • MICRON-GRINDERS
SEPARATORS • BLENDERS • GRANULATORS
CONVEYORS • ELEVATORS

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are

# IEARPROOF





Lower cost per year valve service is guaranteed by Homestead Lubricated Plug Valves. These are the features that make them leak-proof and extend their useful life . . . reinforced Teflon\* head seal, double ball and lubricant sealed check valve, and their exclusive controlled pressurized lubricant seal.

Homestead's controlled lubricating system

forces a chemical film over all sealing surfaces at more than 300 pounds pressure. In addition, it prevents sticking, by its piston-like movement of the plug during each lubrication. See how Homestead fills your valve needs. Write today for Reference Book 39, (Section 5), for complete information on Homestead Lubricated Plug Valves.

\*DuPont registered trademark.

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HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. Box 13

Coraopolis, Pa.

# This plant costs less to operate because Dracco Dust Control protects product purity avoids serious clean-up problem. Binney & Smith, Inc., manufacturers of nationally known "Gold Medal Crayons", selected a Dracco system to collect organic pigment dusts from production units (below).

Uncontrolled dust in your plant can impair employee health or working efficiency, shorten machine life, contaminate critical materials, cause excessive plant clean-up and maintenance costs and disrupt community relations.

You can trap dust at its source, and eliminate its nuisance, irritating, toxic or abrasive effects—with Dracco Dust Control Equipment. Men and machines work better in clean, pleasant surroundings. Absence of dirt and corrosion keeps maintenance costs lower.

If dust is sapping your profits by causing production slowdowns, downtime and personal discomfort, take positive action. Call or write Dracco today.

DRACCO DIVISION OF

4040 East 116th Street · Cleveland 5, Ohio

# HERE'S HOW TO REDUCE COSTS WITH DRACCO DUST CONTROL:

- Eliminate health and safety hazards by stopping spread of toxic dust
- Lengthen machine life by preventing abrasive wear
- Protect vital materials by trapping contaminating dusts
- Cut plant housekeeping costs by eliminating clean-up problems
- Improve community relations by halting air pollution

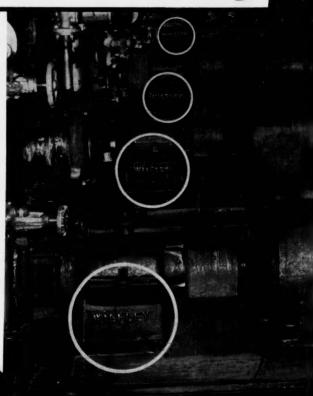
Complete 40-page catalog on Dracco Dust Control Equipment contains detailed data and valuable reference material. Write for Bulletin 800.

TRACE airstream conveyors dust control equipment

# THE NAME THAT PROVES

# Quality=Economy

Pumps that bear the name Wilfley are money savers. Production records consistently prove that Wilfley quality pays off in lower pumping costs. Rugged, heavy-duty construction provides long, trouble-free service on tough as well as easy pumping jobs. Let a Wilfley Acid Pump go to work for you . . . it starts saving money the moment it goes into action. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements.



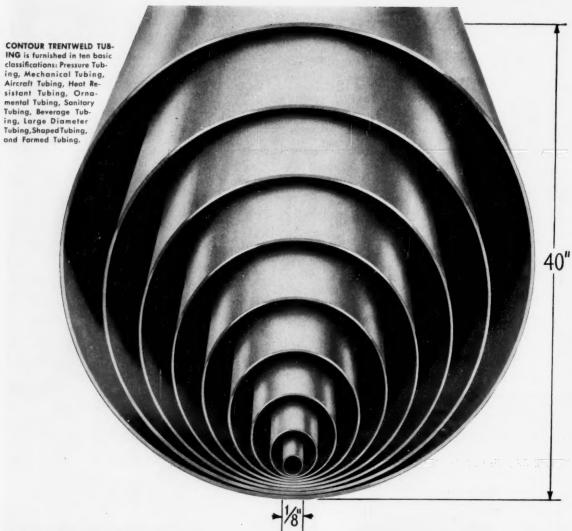
WILFLEY ACID PUMPS

"Companions in Economical Operation"
"Milley Acid Pumps

Write, wire or phone for complete details.

A. R. Wilfley and Sons, Inc.

DENVER, COLORADO, U. S. A.
NEW YORK OFFICE: 122 EAST 42ND STREET, NEW YORK CITY 17



# TRENTWELD tubing is equal in strength and has more uniformity than tubing made by any other method of manufacture

Trent offers tubing in sizes ranging from %" to 40" O.D. and in a wide range of grades. These include: Hastelloy,\* Zirconium, Zircaloy, Titanium and 10-9-DL grades. All are made by an exclusive welding process—Contour Trentweld®—which virtually eliminates the bead. Furthermore, by cold working and annealing after welding, Trent makes the weld equal in strength and corrosion resistance to the parent metal.

To insure that Trentweld tubing

is of the highest quality attainable, a rigorous quality control program is carried out. Samples of each lot are tensile tested. Periodic tests — flattening, reverse bend, flare and flange, coil, and pressure — are conducted. Rigid corrosion tests are made on all lots intended for corrosive applications. When requested, a unique "single-wall" X-ray inspection is made as your final assurance of a sound, uniform product.

Why not take advantage of Trent

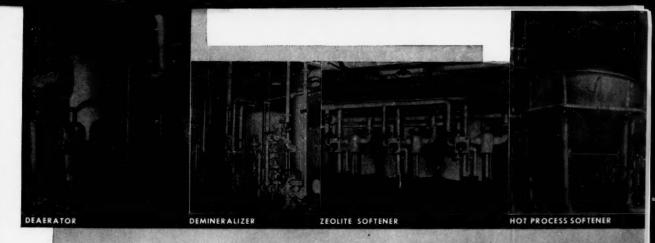
quality when you order stainless or high alloy tubing? For further information, write for the Trent tubing handbook, Trent Tube Company, East Troy, Wisconsin.

\*Trademark of Haynes, Stellite Co

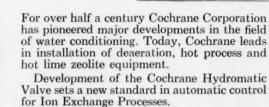


#### TRENT TUBE COMPANY

Subsidiary of Crucible Steel Company of America GENERAL OFFICES: EAST TROY, WISCONSIN MILLS: EAST TROY, WIS.; FULLERTON, CALIF.

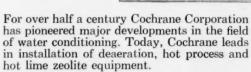


# Engineering and Equipment by Cochrane assure complete water conditioning service

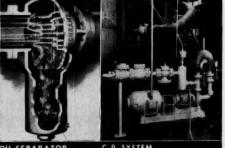


Cochrane's background as heat engineers has also been responsible for the development of steam specialties recognized and used throughout industry today. The C-B Jet Pump improves heat transfer, reduces drying costs with resultant product improvement and usually

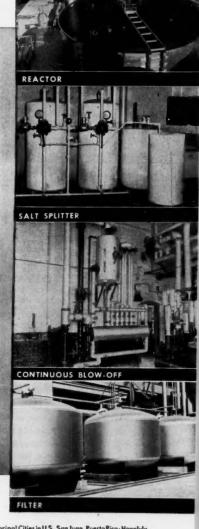
provides a single responsibility for continuous satisfactory operation of every installation. It is an assurance that guarantees will be met.



increases production output. This complete service, available at Cochrane, Why not consult Cochrane?







MULTIPORT RELIEF VALVE

MULTIPORT DRAINER

STEAM PURIFIER

Representatives in Thirty Principal Cities in U.S., San Juan, Puerta Rico; Ho Hawaii; also: Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Diego, Chile; Manila, Philippine Islands. Pottstown Metal Products Division—Custom built carbon steel and alloy

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Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blowoff Systems • Condensate Return Systems • Specialties

#### Progress with TITANIUM

Giant autoclave is divided into six inner compartments, each with a turbine impeller for agitating slurry, which contains cobalt, nickel, copper arsenic, iron and sulfuric acid, and ironarsenic compounds. The reaction is carried out at pressures of 550-600 psi, at temperatures exceeding 400°F. The Calera Mining installation, at Garfield, Utah, was engineered by Chemical Construction Corporation.



# 4TH BIRTHDAY FOR TITANIUM TURBINE

#### in corrosive slurry that quickly kills other metals

THIS encrusted, scale-covered turbine impeller made from Mallory-Sharon titanium is a thing of beauty to the cost-conscious Calera Mining Company. It's passing inspection after four years service in as corrosive an environment as you are likely to meet.

Calera oxidizes and leaches cobaltarsenic-sulfide concentrates in a giant high-pressure, high-temperature autoclave. The autoclave, or pressure vessel itself is lined with acid resisting brick. But the turbines, piping, thermowells, and flange linings must be metal.

The piping, fabricated from Mallory-Sharon titanium, has seen continuous service—where alloy steels and nickel alloys failed in a matter of hours. Even on the hefty turbines, the longest service obtained was a few weeks—before titanium was fully specified for all turbine parts including fasteners. With flange linings and other parts the story is

the same—titanium is the only choice from an economic standpoint.

Have you a corrosion headache that titanium can turn into a success story? We can help you evaluate this remarkable metal in your plant, supply engineering assistance, and deliver your sample or prototype requirements from stock. Call or write now for complete information.

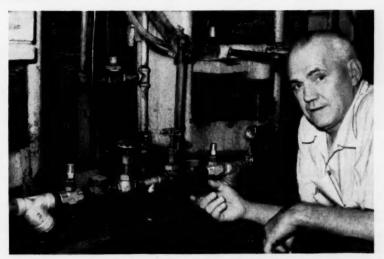
#### MALLORY-SHARON

METALS CORPORATION . NILES, OHIO



# "our Yarway Impulse Traps give good performance, free from worry"

- Q. Mr. Terrill\*, you have more than 100 Yarway Impulse Steam Traps on almost every press in this Boonton Molding Co. plant. Why do you use Yarway?
- A. Because we never have to worry about them. They give good performance on our presses 24-hours a day and never cause any trouble.
- Q. How long have you been using Yarways?
- A. We started 5 years ago. Now we're almost 100%. There are only a few other type traps left. They'll soon be replaced by Yarways.
- Q. These presses are pretty hot. At what temperatures do you mold?
- A. About 350°F. That's another advantage of Yarways. They keep the presses at high molding temperatures.



"Our presses are individually trapped with Yarways - over 100 of them in the plant"

- Q. Any other advantages?
- A. Sure. Small size, small inventory of parts, and they're easy to order from our distributors.



"Yarways never cause us any trouble"

For free copy of new booklet, "The Why and How of Steam Trapping," write:

YARNALL-WARING COMPANY 137 Mermaid Avenue Philadelphia 18, Pa.

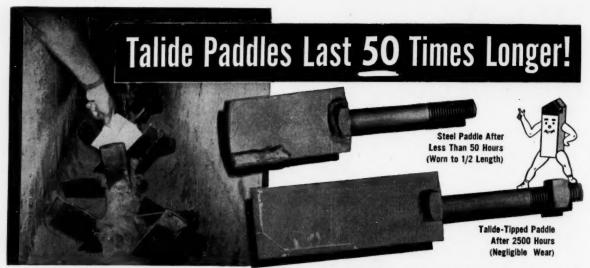
STANLEY TERRILL,
Plant Engineer, Boonton Molding Co.,
Boonton, New Jersey



...a <u>good</u> way to specify steam traps



OVER 1,200,000 YARWAY IMPULSE STEAM TRAPS ALREADY USED • STOCKED AND SOLD BY 275 CONVENIENT LOCAL INDUSTRIAL DISTRIBUTORS • NATION-WIDE YARWAY ENGINEERING STAFF AT YOUR SERVICE.



#### HARDEST MAN-MADE METAL!

TALIDE METAL, a tungsten carbide of superior quality, is harder, stronger, and more resistant to abrasion than any other metal. Properly applied, it gives superior service on applications where wear, heat, strain, and shock are destructive to other metals.

- ABRASION RESISTANCE— Up to 100 times that of steel.
- COMPRESSIVE STRENGTH—Higher than all melted, cast or forged metals and alloys.
- RESISTANCE TO DEFORMATION—2 to 3 times greater than steel.
- MEAT RESISTANCE—Resists oxidation and thermal shock up to 1500° F.
- THERMAL EXPANSION—Less than half the rate of steel, "creep" is negligible.
- FRICTIONAL RESISTANCE—Lower than steel, non-galling, "slippery" properties higher.

ALL TALIDE METAL grades are made in latest type vacuum electric furnaces by precision methods under rigid control. A wide variety of shapes and sizes can be supplied—up to 25" in diameter, 100" in length, and 5000 pounds by weight. Parts can be supplied to any grit finish required down to one micro-inch. The physical properties of the most commonly used grades are listed below. Other grades are available for specialized applications.

#### PHYSICAL PROPERTIES OF TALIDE METAL (P. S. I.)

Application	Operation	Talide Grade	Rockwell "A" Hardness			Compressive Strength	Co-Efficient of Thermal Expansion	Modulus of Elasticity (Deflection)
WEAR SURFACE	No Shock	C-91	91.8	14.90	235,000	710,000	3.00 x 10-6	91,000,000
	Light Shock	C-99	91.0	14.75	265,000	670,000	3.65 x 10-6	84,000,000
	Medium Shock	C-88	89.5	14.55	295,000	635,000	4.00 x 10-6	80,000,000
IMPACT	Light	C-85	88.4	14.25	315,000	600,000	3.75 x 10-6	77,000,000
	Medium	C-80	87.0	13.85	335,000	550,000	4.50 x 10-6	74,000,000
	Heavy	C-75	85.0	13.15	355,000	500,000	5.00 x 10-6	70,000,000

Note: Hardness values may vary plus or minus .2 to .3 on individual lots.

Send for new 76-page catalog 56-G or ask for sales engineer to call.

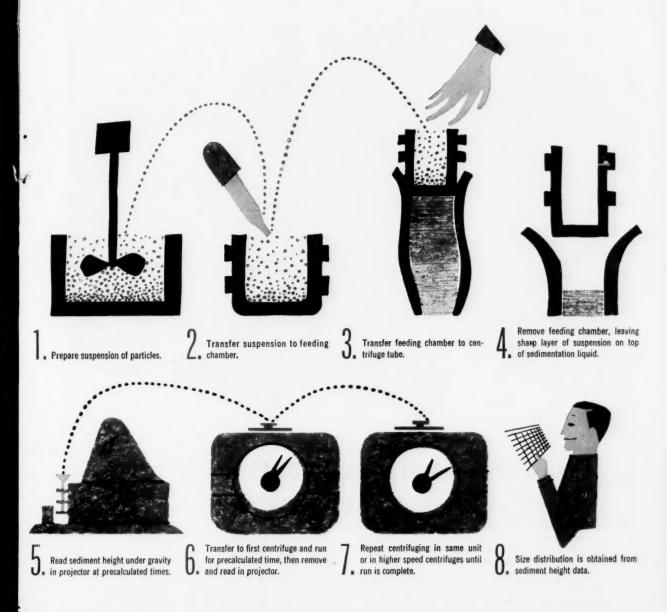
Metal Carbides Corporation Youngstown 12, Ohio Leading brick manufacturer reports Talide-tipped pug mill paddles have outlasted 50 sets of hardfaced steel paddles to date—and are still in use. Operation involves mixing abrasive ceramic, clay and brick compositions.

TALIDE METAL is saving industry millions of dollars annually by wear-proofing vital parts on machine tools, presses, pumps, compressors and other types of processing equipment used in the steel, oil, chemical, plastic, auto, rubber, textile, glass, ceramic, mining and metalworking industry.



TALIDE

HOT PRESSED AND SINTERED CARBIDES . VACUUM METALS
HEAVY METAL . ALUMINUM OXIDE . HI-TEMP. ALLOYS
OVER 25 YEARS: EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



# New Low-Cost Way to Measure Size Distribution of Small Particles

With the new M-S-A® Particle Size Analyzer, you can start with a minimum investment for measuring particle distribution, and then expand it by the purchase of additional components.

This versatile analyzer is a generalpurpose device for measuring size distribution of small particles. It is especially designed for measurement of subsieve particles between approximately 0.1 and 40 microns. Most airborne dusts, paint pigments, and many flours, chemicals, and pharmaceuticals lie within this range.

Complete analyzer system includes centrifuge tubes, feeding chamber, optical tube projector, one or more special centrifuges, and tube handling and cleaning accessories. Write for new bulletin for details.







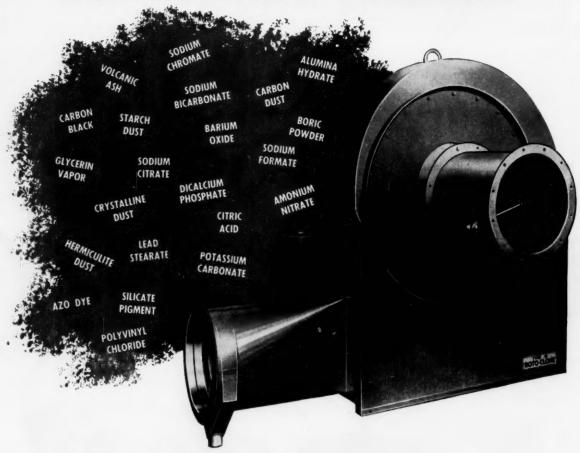
Centrifuges



#### INSTRUMENT DIVISION

Mine Safety Appliances Company Pittsburgh 8, Pennsylvania

# Do you have a DUST PROBLE



# AAF TYPE W ROTO-CLONE DOES MANY JOBS FOR CHEMICAL PROCESSORS

If your operations require collection of fine dust particles in moderate concentrations, you've got a job for the AAF Type W ROTO-CLONE.

The ingenious addition of water sprays extends the effectiveness of this dynamic precipitator to collection of the finest, lightest dust particles. The compact Type W ROTO-CLONE provides everything you need, except duct connections, in one complete shop-assembled package.

The Type W requires little maintenance, uses a minimum of water and maintains efficiency regardless of variation in air volume. It can be made of special metals or protected with most coatings at modest cost. For complete information, call your local American Air Filter representative or write direct for Bulletin 272B.



326 Central Avenue, Louisville 8, Kentucky crican Air Filter of Canada, Ltd., Montreal, P. Q.







February 10, 1958—CHEMICAL ENGINEERING

# EAST COAST ETHYLENE



E sso Standard Oil Company's new Ethylene Plant at Bayway, New Jersey is the first to be located on the East Coast. The ethylene product is distributed through Esso's pipeline system to petrochemical plants in this strategic marketing area.

The plant produces its own steam from transfer line heat exchangers and waste heat boilers, and pipes surplus steam to the Esso refinery steam system. Refinery gas forms the feedstock for this large capacity, high purity ethylene plant.

The plant is typical of the design, construction and engineering services Stone & Webster Engineering Corporation provides the process industries for every type of installation, both large and small, throughout the free world.

Write or call us for information as to how our experience may be of assistance to you.



# STONE & WEBSTER ENGINEERING CORPORATION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

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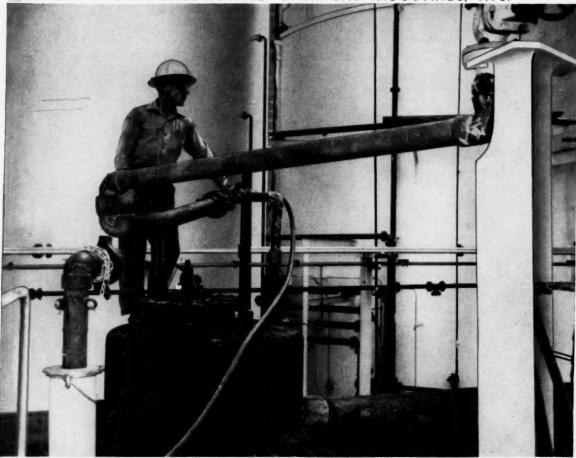
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REPORT FROM CONSOLIDATED CHEMICAL INDUSTRIES, INC.



# Give your product a <u>SAFE</u> SENDOFF Use **CHIKSAN** LOADING ARMS

Consolidated Chemical Industries is safety conscious! They use Chiksan loading arms for tank car loading of sulphuric acid.

To assure complete safety in your loading operations, Chiksan manufactures loading arms and ball bearing swivel joints from the same materials used in the piping systems. Steel, malleable iron, nickelbronze, stainless steel and special alloys are used... meeting most chemical requirements. Chiksan ball-bearing swivel joints speed the loading and unloading of both liquids and gases... safely. Send for your copy of our free catalog which shows complete Chiksan lines and standard loading arm designs.



Chiksan Swivel Joints rotate 360° in 1, 2 and 3 planes, handling air, hydraulics, fuels, oils, water and other fluids.

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION





CHIKSAN COMPANY, Brea, California - Chicago 3, Illinois - Newark 2, New Jersey - Well Equipment Mfg. Corp., (Division)
Houston 7, Texas - Chiksan Export Co., Brea, California; Newark 2, New Jersey - Chiksan of Canada, Ltd., Edmonton, Alta.



long-run power by Allis-Chalmers

### If you specify "Allis-Chalmers motors or equal"

... remember that the "equal" is possible only in two respects: price and nameplate specifications. You can't match the long-run power of Allis-Chalmers motors.

Double-shielded bearings guarded against dirt and overgreasing... provision for elimination of moisture condensation ... practically indestructible rotor design... more cooling surface... more iron and copper content — these are the features (with others) that make up long-run power. These are the features that give Allis-Chalmers motors "plus" performance that can't be equalled.

**Find out more** about the motors with long-run power from your A-C representative or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



## Valve diaphragm of R/M TEFLON\* helps speed production of polio vaccine!

Here's how Raybestos-Manhattan cooperated with a customer to make possible faster production of vitally needed Salk polio vaccine.

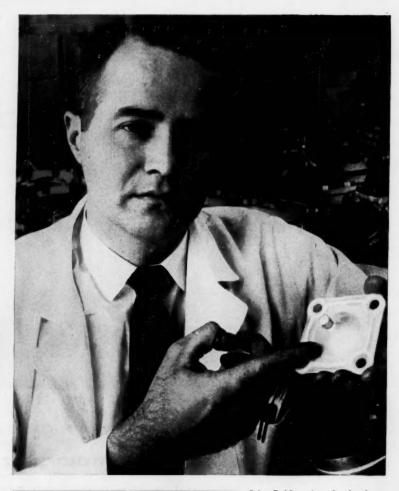
Salk vaccine is 20 days in the making, requires another 110 for testing. During this time the portable processing tanks must be sealed off from all possibility of contamination. Processing temperatures range from 5 to 150°C. Diaphragin valves were chosen for this work because they make possible complete cleaning and sterilization.

The solid valve diaphragms originally used were unable to withstand the extreme operating conditions involved. R/M "Teflon" was selected for the task because of its strength, flexibility, chemical inertness, and capacity to endure—unchanged—the wide range of temperatures necessary.



R/M worked closely with the customer and promptly developed a new method of molding a "Teflon" valve diaphragm ideally suited to this exacting need. The new "Teflon" diaphragm was much thinner than the one formerly used, with improved flex life that permitted a greater number of manufacturing cycles—this without danger of valve failure at a critical point in the process.

\*A DuPont trademark





Other R/M products for the chemical industry include flexible thinwall "Teflon" hose; custom-machined parts; rods, sheets, tubes and tape; centerless ground rods held to very close tolerances; stress-relieved molded tubes and rods; gaskets, expansion joints, and flexible couplings; bondable tape and sheets for linings; Raylon (R/M trade name for mechanical grade "Teflon") which has many characteristics of virgin "Teflon."



#### RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

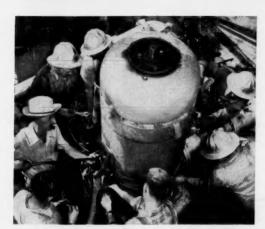
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RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber • Sintered Metal Products • Rubber Covered Equipment Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls



### Where service begins-LAYNE



A telephone call brings action—for the service facilities, know-how and experienced work crews of your nearby Layne Associate Company.

Layne service is based upon undivided responsibility throughout every phase of every water development job, from initial surveys and construction, to operation and maintenance.

For service before, during and after well construction, look to Layne and your nearby Layne Associate Company, a member of the community it serves.

Completely equipped work crews handle water well and pump servicing — backed by over 75 years of field experience



Water Wells • Vertical Turbine Pumps • Water Treatment

#### LAYNE & BOWLER, INC.

Memphis 8, Tennessee

Gentlemen:

Please send me Bulletin No. 100

Name\_

Title\_

Organization\_\_\_\_

Address

City\_\_\_

State\_



## ALUMINUM GATE VALVES

#### by Darling

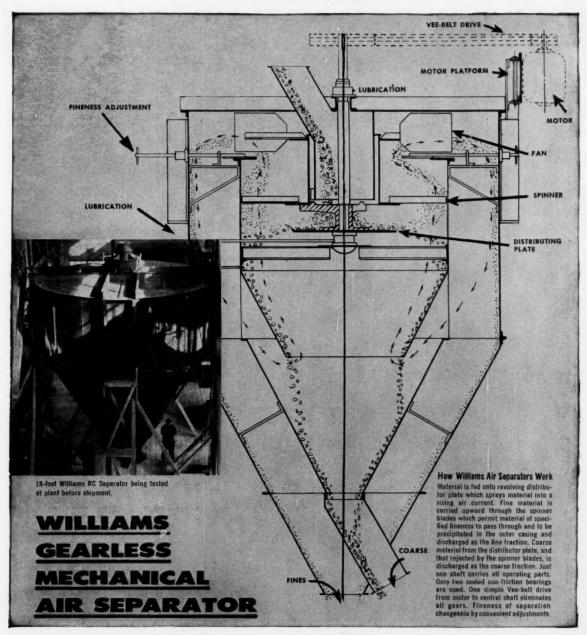
Darling gate valves of aluminum alloy offer all of the unique, extended-life features inherent with the Darling fully revolving double disc, parallel seat principle... for performance that assures unmatched economy... and freedom from leakage, trouble and downtime!

These Darling aluminum alloy valves are now available in ½" through 24" sizes. Write for full details, specifying your particular service requirements.



DARLING VALVE & MANUFACTURING CO.

WILLIAMSPORT 3, PA.



#### 20 To 325 Mesh Separations—Trouble-Free Gearless Operation

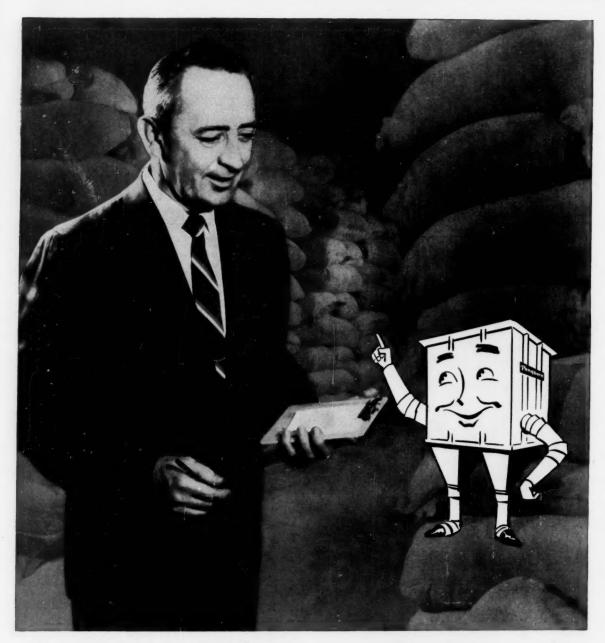
For removing fines from coarsely ground material or for making separations of fine material (the separations ranging from 20 to 325 mesh), Williams Mechancial Air Separators provide the lowest cost, maximum production equipment yet devised. Separation is by specific gravity and no fine delicate screens are employed. Output is unusually high even for fine separations. Construction is heavy duty throughout with heavy steel plate casing, simple gearless drive

and heavy internal construction. Only two antifriction bearings are used. They are enclosed in dust-proof and moisture-proof housings. All sizes permit adjustment for wide variation in fineness of separation. Let us send you complete information.

9 Standard sizes. Capacities, 1/4 ton to 75 tons hourly.

WILLIAMS PATENT CRUSHER & PULVERIZER CO. 2706 North 9th Street St. Louis 6, Mo.





#### "You mean \$15,000 a year salvaging dust?"

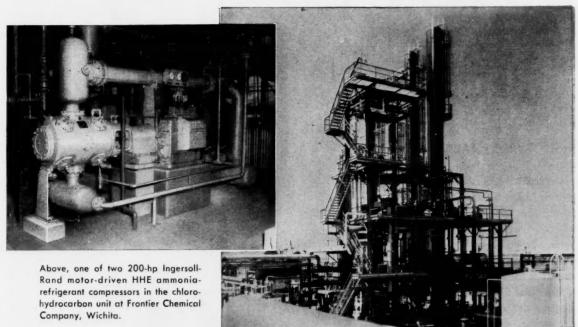
That's just what we mean! Many of our customers are clearing \$15,000 a year and more from valuable material reclaimed by Pangborn Dust Control. Efficient Pangborn Dust Collectors trap dust at the source, gather it ready for resale, re-use or disposal. As a matter of fact, users of Pangborn Dust Control have made \$20,000, \$36,000, even \$75,000 a year in salvaged dust, depending on the value of the dust collected.

What's more, Pangborn gives you other benefits of lower housekeeping costs, longer machinery life, higher employee efficiency and better employee and community relations. And Pangborn offers a complete line of collectors for all jobs.

Why not discover how you can profit from Pangborn Dust Control? Write for Bulletin 922 to Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control & Blast Cleaning Equipment.

## Pangborn DUST

## Frontier Chemical uses R compressors for new chlorohydrocarbon process



Frontier Chemical Company's new chlorohydrocarbon plant at Wichita, Kansas, is now on stream

helping to meet the booming demand for such

products.

Designed by Frontier engineers and C. F. Braun, and built by J. F. Pritchard & Co., the new plant features reactor equipment different from any used before in this process. Reaction is at moderately high temperature, and the feed preparation step includes fractionation at super-low temperature rather than the common oil-absorption method.

The Front End of the system employs two 200-hp Ingersoll-Rand HHE ammonia refrigerant compressors. These horizontal electric-driven units are two-stage, the low-pressure cylinders being completely encased with insulation and coated with mastic.

Other I-R Process Equipment at the plant includes a non-lubricated instrument air compressor, a two-stage ethylene compressor, and an I-R vacuum pump which was purchased second-hand six years ago and since has given absolutely trouble-free operation. There are also a number of I-R centrifugal pumps.

Repeat Orders...There are a number of varied I-R compressors now on order for the plant, including a new-type four-stage methane compressor. Repeat orders on process equipment such as this are common at Ingersoll-Rand, where the world's most comprehensive compressor experience... and the most process experience... result in the best unit for any service.

Ingersoll-Rand engineers can help you solve your process equipment problems. Call your I-R representative today.

#### Only I-R compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of straight-lifting stainless-steel channels and leaf springs, with trapped-air spaces which cushion action, prevent impact.



COMPRESSORS · GAS & DIESEL ENGINES · PUMPS · AIR & ELECTRIC TOOLS · CONDENSERS · VACUUM EQUIPMENT · ROCK DRILLS

### HOW

#### HERCULES

### HELPS...

DO-IT-YOURSELF FANS—New Red Stave\* cellulose wallpaper paste based on Hercules® CMC makes home decorating easy. Red Stave cellulose paste is fast mixing and slow setting, will not stain or sour and is mold and vermin-proof. This new paste provides the same high quality and performance that has made Huron Red Stave wheat paste the professional paper-hanger's choice for over 25 years.

\*Hercules trademark





BEAT THE WEATHER—Rubber and plastic rain gear today protects you from head to toe against winter storms. Hercules is a basic supplier of essential materials used in their manufacture. Dresinate® emulsifier, Di-cup® curing agent, hydroperoxide catalysts, defoamers, and solvents serve the rubber industry while Hercoflex® plasticizers are important processing aids in the production of vinyl products.

#### HERCULES POWDER COMPANY

900 Market Street, Wilmington 99, Delaware

CHEMICAL MATERIALS FOR INDUSTRY





**ONLY TYPE II insures maximum protection.** It is specifically designed to exclude water and dirt from the motor interior even under the most severe conditions as driving rain and snow, dust storms, salt spray and blizzards.

NEMA specifications say that Type II machines shall have—in addition to the protection covered by Type I—ventilating passages at both intake and discharge so arranged that high velocity air or air-borne particles . . . can be discharged without entering the internal ventilating passages leading directly to the electric parts . . . These and other NEMA requirements were incorporated in Elliott weather-protected machines long before these standards were established to assure optimum protection and eliminate costly housing.

FIFTY YEARS of unmatched large motor leadership. Proudly following a fifty-year-old tradition of building every motor "better than necessary," Elliott engineers consistently design and build progressively more rugged and better large induction motors—with Fabri-Steel construction, Fabri-Seal coil insulation and easy accessibility for routine maintenance. For complete engineering data, write Elliott Company, Ridgway Plant, Ridgway, Pa.



HOW THE ELLIOTT ENCLOSURE

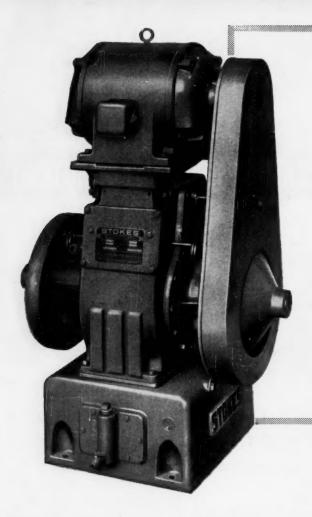
The Ethiott design provides screened horizontal air inlets which permit through passage of wind-driven rain, snow or sand. It offers multiple baffles which impose numerous direction and velocity changes on the entering air—assuring efficient removal of air-borne moisture.

And finally, when desirable, large cleanable air filters are provided above the water separation chambers, to insure maximum sustained air-cleaning effectiveness.

R8-7

ELLIOTT Company





## VERTICAL Design

vacuum pump saves you floor space

If floor space for your vacuum system installation is a problem, here's an "assist" from Stokes. Special Stokes vertical design cuts floor space requirements. For example, the 130 cfm Model 212 Microvac measures less than 3 feet on a side... makes your entire set-up smaller.

And together with these features of compactness, you get a 15% increase in pumping capacity . . . at no increase in price. In this way, Stokes Microvac pumps measure up as the standard of comparison for reliable, low-cost performance.

Here's what you get with the Microvac line:

Minimum maintenance—mechanical face seal eliminates oil leakage at shaft. No stuffing boxes. Fully automatic lubrication.

- Wide pressure ranges—new exhaust valve design assures trouble-free operation during extended pumping periods, in the high pressure range.
- Dirt troubles prevented—intake screen filter traps dirt, scale and other damaging solids.
- Added protection—new oil filter in the line supplies extra protection to bearings and shaft seal.

Microvac pumps give you the high efficiency you want ... used separately or as roughing pumps with diffusion or booster pumps. Write for catalog 752, "Stokes Microvac Pumps for High Vacuum"; Booklet 755, "How to Care for Your Vacuum Pump"... or call your nearest Stokes office to find out how we can help you solve your particular vacuum application problem.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.





#### Send for this important brochure!

Learn how a versatile Jupiter®
gas turbine engine can help solve your
power problems

solar's 500 HP JUPITER gas turbine offers a radical new power concept for forward-looking businesses. One of the simplest of all heat engines, it is especially suited to applications where there are interrelated requirements for shaft power, processing heat and compressed air. New users praise its high power-to-weight ratio, its instant starting under severe temperature extremes, its low maintenance requirements and its ability to burn a wide variety of fuels.

Solar has prepared a colorful

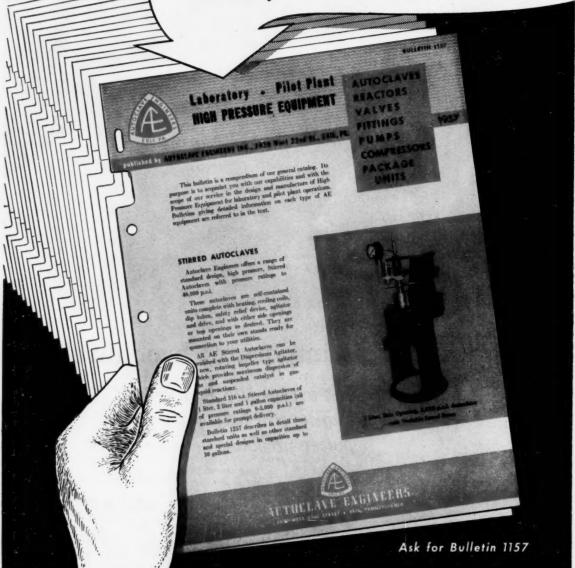
24-page booklet giving full details about the Jupiter. It contains all of the information necessary to acquaint you with the many advantages of this exciting new engine—and it's yours for the asking. Learn how this power plant of the future can go to work for you—today! Write to Dept. D-138, Solar Aircraft Company, San Diego 12, California. Designers, developers and manufacturers of gas turbines, expansion joints and aircraft engine, airframe and missile components.

	OLA		SAN DIEGO
IRCE	AFT CO	MPANT	DES MOINES
FOR N	EW JUPIT	ER BROCHURE	MAIL TO:
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San D	liego 12,	California.	
NAME			
TITLE			
COMPAN	YY		

ENGINEERS WANTED. Unlimited opportunities, challenging projects, good living with Solar! Write for new brochure.

#### Your COPY OF THIS NEW REFERENCE BULLETIN IS READY -

Write for it! A "BRIEF" on the complete line of AE High Pressure Equipment





Autoclave Engineers
2932 WEST 22nd STREET • ERIE, PENNSYLVANIA

## You May Profit From This Book

if you are concerned with processing that involves temperatures ranging upwards to 4000°

if your progress in processing depends upon materials of high purity.

if it would help you to obtain a modern material with unusual electrical characteristics.



Here is a valuable reference book that tells you all about the chemical and physical characteristics of such materials as CRYSTOLON\* Silicon Carbide, ALUNDUM\* Aluminum Oxide, MAGNORITE\* Magnesium Oxide, Fused Zirconia and Boron Carbide.

Describing how these electrochemically refined materials react under varying conditions, this book gives you plenty of facts on materials that are helping to solve processing problems.

Get this useful help towards solving your own processing problems. Write today for your free copy of "Norton Refractory Grain." NORTON COMPANY, Refractories Division, 501 New Bond Street, Worcester 6, Mass.

\*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

## NORTON

D

Engineered ... R ... Prescribed

Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories BEHR-MANNING PRODUCTS: Coated Abrasives Sharpening Stones • Behr-cat Tapes Operating at Increased Temperatures and Pressures?

## Special Armco Stainless Steels Can Help Keep Your Plant "On Stream"



ARMCO STEEL CORPORATION, 1238 Curtis Street, Middletown, Ohio

Send me additional data on the Armco Stainless Steels for chemical processing equipment.

Armco ELC

Armco 17-4 PH and 17-7 PH

Armco 17-14 Cu Mo

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Company

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City

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State

If the increased temperatures and pressures required for higher efficiencies are giving you material-selection and maintenance problems, try the solution found effective by many design and plant engineers . . . special Armco Stainless Steels. For severe operating conditions, they provide unusual combinations of corrosion- and oxidation-resistance, high temperature strength and hardness, plus excellent fabricating characteristics.

#### **Advantages of Special Armco Grades**

Here are a few of the unique stainless steels produced by Armco and the reasons why they can help you avoid unscheduled shutdowns:

Armco ELC Stainless — Extra-low carbon variations of Types 304, 316, and 317. Provide low-cost insurance against intergranular corrosion due to carbide precipitation adjacent to welds. Ideal for field welding.

Armco 17-4 PH and 17-7 PH Stainless — Precipitationhardening grades with unusually high strength and hardness up to 900 F; resistant to galling and abrasion. Useful for pump shafts, springs, valve diaphragms and stems, and high strength bolts.

Armco 17-14 Cu Mo Stainless—An economical corrosionresistant material for long-time service up to 1500 F. Has exceptionally high rupture and creep strength.

Armco 22-4-9 Stainless—Ideal for applications requiring high hardness and strength as well as resistance to erosion, corrosion and oxidation at temperatures from 900 to 1600 F.

Give your chemical processing equipment operational and maintenance advantages by specifying Armco Special Stainless Steels. Supplemented by Armco's complete line of standard stainless grades, they help you do the job at least cost.

For additional information, just fill out and mail the coupon.

#### ARMCO STEEL



ARMCO STEEL CORPORATION . 1238 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION



Wet filtration fabrics of DYNEL resist a wide variety of acids, bases, oxidizing agents and solvents. Because DYNEL withstands the effects of chemicals, it brings major cost advantages to your filtering operation-less down-time, fewer replacements, reduced labor costs.

Air Filters - Now, too, DYNEL is proving out in air filters. Its high efficiency, long life, and reasonable restriction again mean lower costs, improved dust-removal. Write for information, giving a brief description of the filter problem you may have. Address Dept. CE.

DYNEL • a



textile fiber

Textile Fibers Department, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd St., New York 17, N. Y. Offices in Boston, Mass. • Charlotte, N. C. • Montreal, Que. • Toronto, Ont. "Union Carbide" is a registered trade-mark of U.C.C.



#### You'll never have to nurse this O2 Analyzer

What are your most serious complaints about O<sub>2</sub> analyzers? Cumbersome? Slow? Unstable? Hard to service on the job?

You won't find these potential trouble-sources in our new Unitized  $O_2$  Gas Analyzer. They've been literally "designed out" by L&N engineers with experience totaling millions of man-hours in industrial gas analysis.

The Unitized O<sub>2</sub> Analyzer is reduced to the essentials consistent with highly efficient O<sub>2</sub> measurement and control. The entire analysis is made within the 2-component team of O<sub>2</sub> Analyzer Assembly and Speedomax® recorder, eliminating unwieldy auxiliary components such as sample conditioners. Due to its direct magnetic operation, the equipment employs neither auxiliary gas supplies, chemical reactions, nor combustion. Sample and calibration controls are accessible externally, without disturbing the measuring system.

We've introduced sampling innovations, too. The Analyzer gets a sample not only cleaned but purified. A typical sampling lag is 1 sec per 45 ft of  $\frac{1}{4}$ " tubing, up to several hundred feet.

The Unitized  $O_2$  Analyzer can help to streamline  $O_2$ -dependent processes. For pertinent details of this  $O_2$  monitor, write to 4916 Stenton Ave., Phila. 44, Pa., for Folder ND46-91(5).

#### PERFORMANCE

Range 0 to 5%  $O_2$ , 0 to 10%  $O_2$ , or higher in flue gas or  $N_2$  as specified.

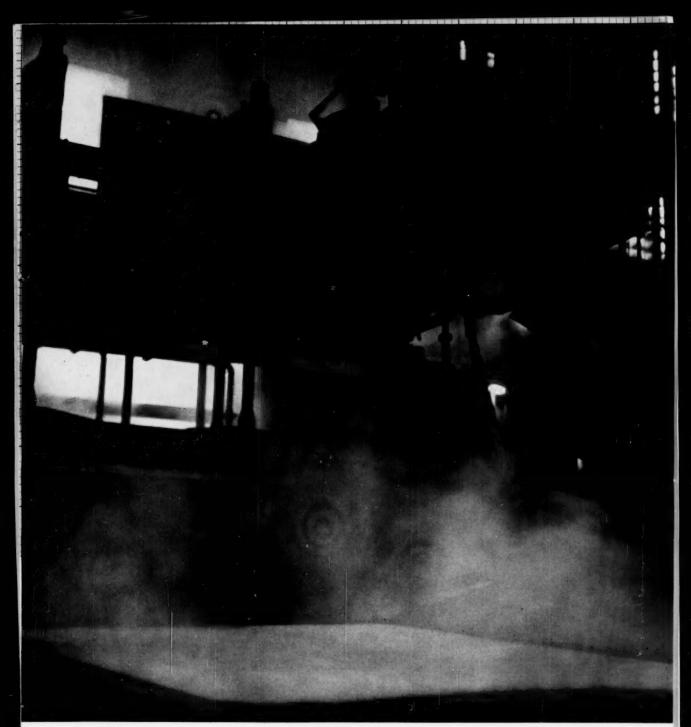
Accuracy  $0.15\%~O_2$ 

Sensitivity Better than  $\pm 0.05\%$   $O_2$ Stability Better than  $\pm 0.15\%$   $O_2$ Response 4 sec for initial response;

40 sec for 90% response.







Claymont's 160-inch plate mill in action. Fully integrated steel producing facilities and a complete range of fabricating equipment make Claymont a reliable source of quality steel plate and plate products for industry.

Photo by d'Arazien

### CLAYMONT STEEL PLATES



CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates
High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed
and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products
Large Diameter Welded Steel Pipe

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION
Plant at Claymont, Delaware • Sales Offices in all Key Cities



## Take the tedium out of correlation studies with this powerful electronic computer ROYAL PRECISION LGP-30

#### Large capacity ... easily programmed and operated ... mobile ... low in cost

Compact, simple to use . . . Royal Precision LGP-30 brings high-speed electronic computation right to your desk . . . relieves you of the tedium of statistical analysis in such areas as research and product development, quality control and process control. And at the lowest cost ever for a complete computer system!

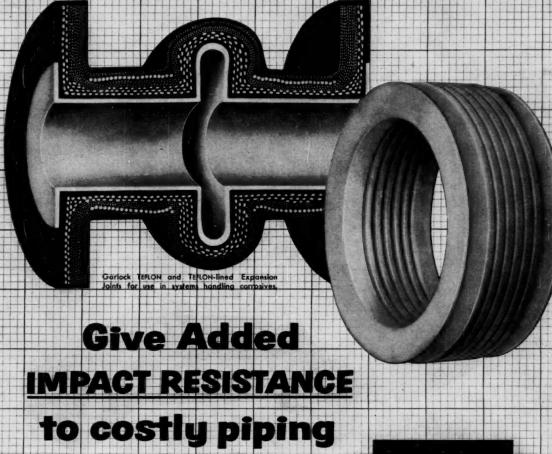
Faster answers; unusual capacity. Used wherever you want it, LGP-30 operates from any conventional wall outlet, is self-cooled. Providing fast, effortless answers for all types of statistical studies—correlations, analysis of variance, regression analysis, curve-fitting—LGP-30 gives you speed and memory (4096 words) comparable to computers many times its size and cost . . . stored-program operation for complete flexibility. Result: you save valuable time . . . handle more assignments . . . go forward to truly creative work.

Easy to operate and program. Controls have been so thoroughly simplified, LGP-30 may be operated with only minimum computer experience. Answers are printed out directly . . . do not require deciphering. Programming is easily learned. A library of sub-routines, plus programs for a wide variety of applications (including Box technique for experimental design), are available. Wide range; exceptional value. The most powerful computer of its size yet developed, LGP-30 is the greatest value in today's market. Remarkably small initial investment is combined with low operating and maintenance costs. Service facilities are available coast-to-coast. For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

#### ROYAL MCBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS AND MAKER OF DATA PROCESSING EQUIPMENT

MORE OF THE GARLOCK 2,000



Garlock Expansion Joints protect your costly piping from damage caused by shock, vibration, expansion or contraction. Teflon Expansion Joints are recommended when corrosives such as acids, caustics, or solvents are being handled. Teflon-lined Expansion Joints are used in higher pressure systems handling corrosives. All-rubber expansion joints are recommended for water, mild acids, mild caustics, air or exhaust steam at temperatures up to 180°F. The right size and type is available for handling any liquid or gas.

Expansion joints are another important part of "The Garlock 2,000"... two thousand different styles of packings, gaskets, and seals for every need. The only complete line. Ask your Garlock representative for his unbiased recommendations or write for Expansion Joint Folder AD-137.



Cutaway of Garlock All-Rubber Expansion Joint shows steel reinforcing rings which vary in number with size. These Joints are available in sizes from 1%" dia. to 18 feet in diameter.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

For Prompt Service, Contact one of our 30 Sales Offices and Warehouses throughout the U.S. and Canada.





Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products



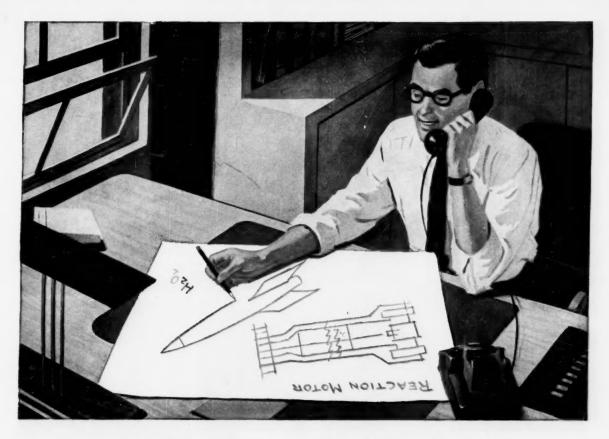
## Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters. No dust filters. No internal lubrication to contaminate air handled. No internal wearing parts. No valves, pistons, or vanes. Non-pulsating pressure. Original performance constant over a long pump life. Low maintenance cost.

NASH ENGINEERING COMPANY
395 WILSON, SO. NORWALK, CONN.



#### Can Becco Research Help You with Propulsion?

Hydrogen peroxide powers reaction motors...operates gas turbines...launches planes...runs rotor-tip motors of helicopters.

As a monopropellant hydrogen peroxide represents a compact power source. It carries its own built-in supply of oxygen to permit combustion of hydrocarbon-type fuels in bi-propellant systems lacking an external or adequate air supply.

Becco Research has been an important factor in

the development of hydrogen peroxide as a power source. A wealth of information and experience, collected over a decade of active research in this field, is available and ready to be applied to problems of using hydrogen peroxide as a source of energy.

#### BECCO CHEMICAL DIVISION

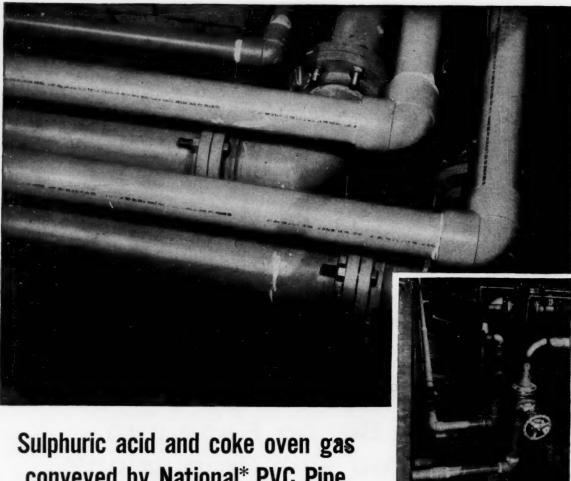
Food Machinery and Chemical Corporation Station B, Buffalo 7, New York

BUFFALO . BOSTON . CHARLOTTE, N.C. . CHICAGO NEW YORK . PHILADELPHIA . VANCOUVER, WASH.

### Progress in Peroxygens BECCO



FMC CHEMICALS INCLUDE: BECCO Peroxygen Chemicals - WESTVACO Phosphates, Barium and Magnesium Chemicals • WESTVACO Alkalis, Chlorinated Chemicals and Carpon Bisulfide • NIAGARA Insecticides, Fungicides and Industrial Sulphur • OHIO-APEX Plasticizers and Chemicals • FAIRFIELD Pesticide Compounds and Organic Chemicals



## conveyed by National\* PVC Pipe

USS NATIONAL Polyvinyl Chloride Pipe is performing two important functions at this steel mill installation:

- 1. It conveys sulphuric acid from acid storage tanks to pickling
- 2. It carries coke oven gas and combustion air from gas booster pumps and air blowers to submerged burners in the pickling

Polyvinyl Chloride Pipe was chosen for its resistance to internal corrosion from the concentrated sulphuric acid. It conveys acid under gravity flow from elevated storage tanks at ambient temperature, and for its external resistance to 10% to 17% concentrated pickling liquid because the

pipes are exposed to acid spillage as steel is lifted from the pickling tanks.

Approximately 650 lineal feet of NATIONAL PVC Pipe were used in this installation. Sizes were 11/2", 3", and 6" diameter-schedule 80, normal impact for sulphuric acid, and high impact for coke oven gas and air. The coke oven gas and combustion air is boosted to 6 to 8 psi at temperatures not over 125°.

NATIONAL PVC Pipe comes in two

NORMAL IMPACT—for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

HIGH IMPACT-for installations requiring excellent chemical resistance and a high degree of toughness, even

at low temperatures.

Available in sizes from 1/2" to 6" inclusive, and in Schedules A (High-Impact only), 40, 80, and 120.

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Specify Bulletin 24.

\*Trademark

This seal of the National Sanitation Foundation means Tested . . Approved . . Sanitary!



NATIONAL TUBE DIVISION,

UNITED STATES STEEL CORPORATION, PITTSBURGH, PA. COLUMBIA-GENEVA STEEL DIVISION SAN FRANCISCO. PACIFIC COAST DISTRIBUTORS UNITED STATES STEEL EXPORT COMPANY, NEW YORK



Why **DYNALOG**\* design is out front of all electronic potentiometers . . .



Advance features to improve control of temperature, pressure, flow . . .

No periodic maintenance
 No dry cell—no standardizing
 No high-speed moving parts
 No slidewire or galvanometer
 Stepless, continuous balancing
 Adaptable to narrow spans

FOXBORO
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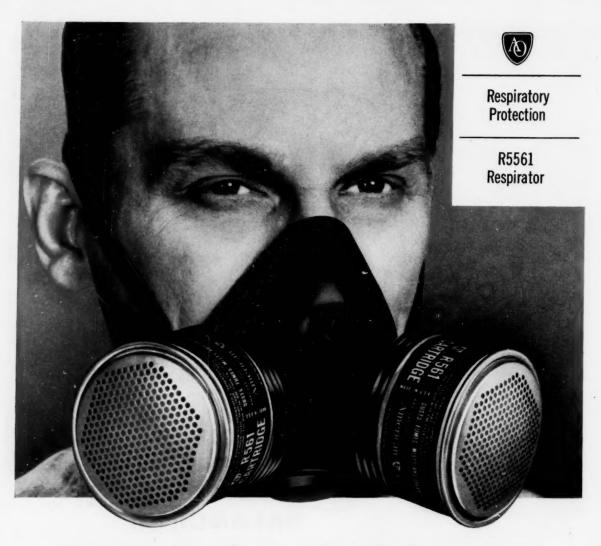
ELECTRONIC WINSTRUMENTS

Here's precision in motion . . . the smooth, continuous balancing action of a Dynalog Electronic Instrument! No slidewire with faltering step-by-step inaccuracies . . . no sliding or rubbing contacts. Instead, a simple, variable, radio-type capacitor and positive magnetic drive. It's friction-free, wear-free.

That's why Dynalogs respond almost instantly to the slightest change in a process variable, with a sensitivity of 1/100 of 1% of scale... accuracy of 1/4 of 1% of scale. It's also the reason they're the maintenance man's dream. About all he does is supply ink and charts!

Dynalogs are used with any primary element—resistance, voltage, capacity, inductive. They perform with effortless accuracy, even on control and recording problems that conventional balancing-type instruments can't handle. For the complete story, write for Bulletin 20-10. The Foxboro Company, 362 Neponset Ave., Foxboro, Mass., U.S.A.

\*Reg. U. S. Pat. Off.



Approved for Multiple Protection - by the U.S. Bureau of Mines\*

#### AO R5561 RESPIRATOR

This respirator is the only one of its kind. No other known respirator can match the many types of approvals awarded to the R5561 by the U. S. Bureau of Mines. One of American Optical's inventory-controlling double cartridge R5000 Series Respirators, the R5561 does a tremendous job of protection, compactly and comfortably.

It is approved by the U. S. Bureau of Mines for protection against industrial respiratory hazards such as pneumoconiosis-producing dusts and mists; toxic dusts and metal fumes not significantly more toxic than lead; chromic acid mist, organic vapors or any combination of these hazards. It is also ap-

proved by the U.S. Dept. of Agriculture for protection against practically all insecticides — including Systox, Parathion, Aldrin, Dieldrin, Chlordane, EPN, Nicotine, TEPP and HETP.

Yes, and by quick interchange of cartridges the R5561 can be converted to any of thirteen other type respirators — to the R5057 respirator, for example, which protects against dusts, mists and fumes significantly more toxic than lead, including radioactive particulate matter. Your nearest AO Safety Products Representative can supply you.

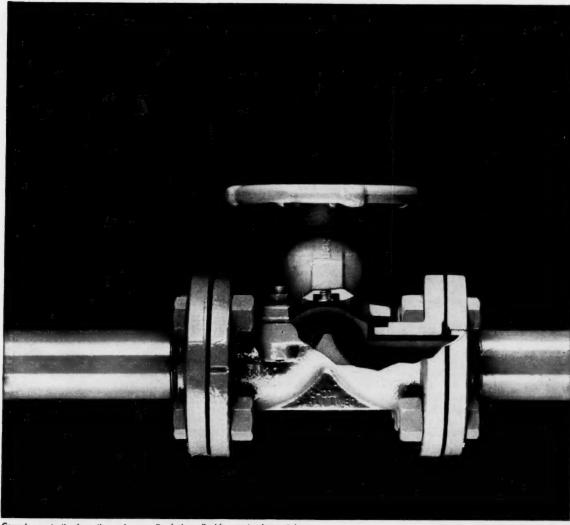
\*Has Every Approval Available on Schedules 21A and 23A

Always insist on

N Trademarked
Safety Products



SOUTHBRIDGE, MASSACHUSETTS
Branches in Principal Cities



Corrosion protection is continuous in saran lined pipe—liquid never touches metal.

#### Here's why Saran lined pipe offers long range economy

It's rigid steel pipe . . . lined with corrosion-resistant saran . . . keeps shutdowns to a minimum for years

Looking ahead? Do your plans call for a complete corrosion-resistant piping system with a low total installation cost . . . a system that requires a minimum of maintenance . . . that's simple to modify . . . that can be fabricated in the field?

Then it will pay you in every way to look into the genuine economy of a complete system of saran lined pipe.

First, consider the natural advantages of the new gray saran lining itself. Its lower coefficient of thermal expansion and contraction more closely approaches that of steel. This provides a broader operating temperature range and greater

resistance to thermal cycling. It can be installed in systems with operating pressures from full vacuum to 300 p.s.i. and temperatures up to 200° F. Add to these advantages the immediate availability of saran lined pipe, valves, pumps and fittings and you have an ideal piping system that can be installed without trouble, waiting or hidden costs.

If your plans call for lined tanks, you'll want the advantages of Saraloy® 898 tank lining added to your saran lined pipe system. Get the complete story on how it will pay you to install a complete saran and Saraloy 898 lined system. The dow Chemical Company, Midland, Michigan.

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2415 BURDET	TE AVENUE
FERNDALE 20	MICHIGAN

Please send me information on:	
Saran lined pipe, fittings and valves.	Name
Saran lined centrifugal pumps.	
Caralou 808 chamical recistant chapting	Address

Name	Title	Company	
Address	Chu	Et-t-	



#### HIGH PURITY RARE EARTHS

#### Available in quantities at surprisingly low cost

a report by LINDSAY

A few months ago, in one of these reports, we presented this table of high purity rare earth and yttrium oxides. We anticipated inquiries, of course, but the flood of letters requesting detailed information really startled us.

What interests us particularly, and will you, is the fact that so many research people are intrigued with the practical possibilities of these unique materials. The large amount of research now being done on high purity rare earth oxides in a wide variety of industries encourages us to suggest the likelihood that they may offer you opportunities for potentially profitable investigation.

Already, in a little more than two years since rare earths in purities up to 99.99% became available in commercial quantities, they are being used as basic production materials in many chemical and industrial operations.

#### Production Up-Costs Down

We have expanded our production facilities to keep up with demand and now have more than 100 ion exchange columns in continuous operation. Quantities are large enough to assure you a dependable source of supply. Prices are low enough to make their use on a production basis economically sound.

Most of the high purity rare earth and yttrium oxides are available for prompt deliveries in quantities of an ounce to hundreds of pounds.

We can't tell you how to use high purity rare earths in your production operations, nor can we promise that one of them may be the missing element in new process or product developments on which you are working. We can, however, supply you with data which you will find interesting, revealing and quite possibly of immediate importance to you.

#### TYPICAL MAXIMUM IMPURITIES IN LINDSAY PURIFIED RARE EARTH AND YTTRIUM OXIDES

NO.	OXIDE	CODE	PURITY	% RARE EARTH MAXIMUM IMPURITIES AS OXIDES
57	La <sub>2</sub> O <sub>3</sub> . LANTHANUM OXIDE	528 529	99.99 99.997	0.01 Pr, 0.001 Ce. 0.0025 Pr, 0.0005 others
58	CeO <sub>2</sub> . CERIC OXIDE	215 216	99.8 99.9	0.2 (largely La + Pr + Nd). 0.1 (largely La + Pr + Nd).
59	ProO11. PRASEODYMIUM OXIDE	726 729.9	99 99.9	1 La + Nd + smaller amounts of Ce and Sm. 0.1 Ce + Nd.
60	Nd <sub>2</sub> O <sub>3</sub> . NEODYMIUM OXIDE	628 629 629.9	95 99 99.9	1-4 Pr, 1-4 Sm, 0.5-1 others. 0.1-0.4 Pr + 0.1-0.4 Sm + 0.5 other 0.1 (largely Pr + Sm).
62	Sm <sub>2</sub> O <sub>3</sub> . SAMARIUM OXIDE	822 823	99 99.9	0.2-0.7 Gd, 0.2-0.6 Eu, and smaller amounts of others. 0.1 (largely Nd + Gd + Eu).
63	Eu <sub>2</sub> O <sub>3</sub> . EUROPIUM OXIDE	1012	98-99 99.8	1-2 Sm + smaller amounts of Nd Gd + others.  0.2 (largely Sm + Gd + Nd).
64	Gd <sub>2</sub> O <sub>3</sub> . GADOLINIUM OXIDE	928.9 929.9	99 99.9	1 Sm + Eu + trace Tb. 0.1 Sm + Eu + trace Tb.
65	Tb407. TERBIUM OXIDE	1803 1805	99 99.9	1 Gd + Dy + Y. 0.1 Gd + Dy + Y.
66	Dy <sub>2</sub> O <sub>3</sub> . DYSPROSIUM OXIDE	1703 1705	99 99.9	1 (largely Ho + Y + Tb + small amounts of others).  0.1 Ho + Y + traces of others.
67	Ho <sub>2</sub> O <sub>3</sub> . HOLMIUM OXIDE	1603 1605	99 99.9	1 (largely Er + Dy + small amounts of others).  0.1 Er + Dy + traces of others.
68	Er <sub>2</sub> O <sub>3</sub> . ERBIUM OXIDE	1303 1305	99 99.9	1 Ho + Dy + traces Yb and Y. 0.1 Ho + Tm.
69	Tm <sub>2</sub> O <sub>3</sub> . THULIUM OXIDE	1405 1403	99.9 99	0.1 Er + Yb + trace Lu. 1 Er + Yb + trace Lu
70	Yb2O3. YTTERBIUM OXIDE	1201 1202	99 99.9	1 Er + Tm + trace Lu. 0.1 Tm + trace Lu + Er.
71	Lu203. LUTETIUM OXIDE	1503 1505	99 99.9	1 Yb + Tm + traces of others. 0.1 Yb + Tm + traces of others.
39	Y <sub>2</sub> O <sub>3</sub> . YTTRIUM OXIDE	1112 1115 1116	99 99.9 99.9+	1 Dy + Gd + traces Tb and others. 0.1 Dy + Gd + traces Tb Approx. 0.05 Dy + Gd.

For detailed information and prices, write for our bulletin "Purified Rare Earth and Yttrium Oxides"



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ARTISAN INDUSTRIES

## How to get maximum combustion efficiency... measure both combustibles and oxygen

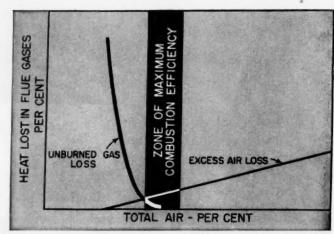
Simultaneous measurement of both oxygen and combustibles is needed to obtain optimum combustion. No instrument that measures only one of these two interdependable factors can give you the full information necessary.

Now, Bailey offers two units, each giving a continuous and simultaneous double check on combustion efficiency: a permanent analyzer-recorder which records both factors on a single chart; and a new light weight, portable unit which indicates both factors.

Both instruments measure: (1) excess air—regardless of the fuel or combinations of fuel being burned, (2) mixing efficiency of your fuel burning equipment by showing per cent combustibles in the flue gas.

Both units are designed to increase efficiency in the furnace operations of the steel industry, on glass tanks, cement and lime kilns, ceramic

and refractory kilns, steam boilers and also on direct and indirect-fired furnaces in the metal processing industries. To prevent your money from becoming waste gas, look



Maximum Combustion Efficiency is secured by keeping the sum of Excess Air Loss and Unburned Gas Loss to a minimum. To do so by the direct method simply measure both oxygen and combustibles in flue gas.

into these two efficiency provers. A Bailey engineer will be glad to give you details or write us for product specifications.

#### For portable use— HEAT PROVER Analyzer



The famous Cities Service HEAT PROVER analyzer is now Bailey built and sold. Weighing only 25 pounds, it is a self-contained automatic analyzer including a sampling tip and hose plus a thermocouple for temperature measurement.

Instrument dials are dual range for greater accuracy and sensitivity.

### For permanent installation Oxygen-Combustibles Recorder



The Bailey Oxygen-Combustibles Analyzer-Recorder coordinates both records on one chart. These records enable the operator to keep fuel burning equipment performing continuously in the zone of maximum combustion efficiency. Excess air may be reduced to the point where combustibles begin to show.

G 40-1

Instruments and controls for power and process

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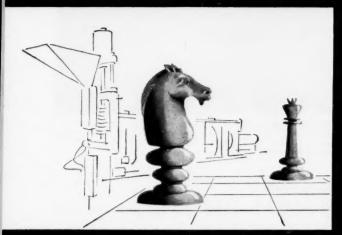
in Canada-Balley Meter Company Limited, Montreal

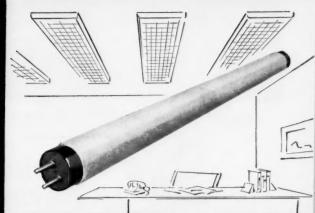


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Mallinckrodt stearates have many uses in industry. Zinc stearate is used as an internal and external lubricant in plastics and also as a flatting agent in lacquers. Magnesium stearate is an efficient mold-releasing agent for plastic items. Calcium stearate is a lubricant and stabilizer in plastics and also improves the plasticity of starch-clay coated papers. Gelling characteristics of aluminum stearates are important in manufacturing greases . . . and in paints they increase pigment suspension without making the paints too thick for easy application.

#### Chemicals for Electronics

The ability of Mallinckrodt research and production chemists to control purity and maintain uniformity of dibasic calcium phosphate and other chemicals needed to manufacture phosphors has played an important part in the development of the fluorescent lamp industry. Mallinckrodt Standard Luminescent chemicals are also used extensively in producing television phosphors. Mallinckrodt TransistAR® chemicals are used in the manufacture of transistors and other semi-conductor devices.

Your particular application of these and other Mallinckrodt industrial chemicals

may be different. Drop us a note on your requirements —

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The Class GGG-38, one of many Richardson Bulk Weighing Scales for the Chemical and Food Processing Industries.

All Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

## Want to slice costs in weighing bulk materials? Let Richardson Do It For You

Today's automated bulk materials handling systems demand scales that can give accurate, trouble-free service on the widest possible range of materials. That's why Richardson scales are used the world over—by chemical plants, food processors, feed and flour mills.

In unit weighing, process weighing or proportioning operations, you get:

- REDUCED PRODUCTION COSTS

   weighing speeds suit any operation, pace production at economical level.
- LONG-TERM RELIABILITY . . . year-after-year rugged, accurate service.
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- SAVINGS IN MATERIALS . . . average accuracies of from 0 to  $\pm$  3 ozs. guard against losses.
- SAVINGS IN LABOR . . . completely automatic equipment means reduced labor and handling expenses.

QUALITY CONTROL . . . accurate measurement keeps quantities and proportions constant.

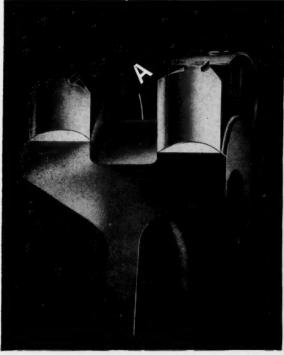
There's a national service organization behind every Richardson application—to keep your scales in prime condition and to advise you on special weighing and materials handling problems. Let us put to work for you our more than 55 years experience in the business of materials handling by weight. For more information call or write us today.

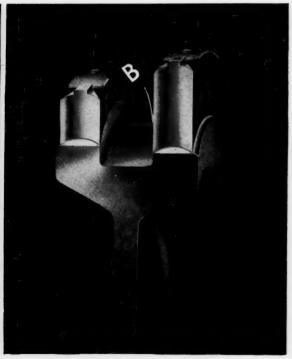


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ALSO MANUFACTURED IN EUROPE TO U.S. STANDARDS

497





(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

## Now...for low steam consumption – COPPUS TURBINES can be furnished with wide bucket "L" type wheel

Good news for steam turbine users where low steam consumption is important!

The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

• Turbines rated close to your exact hp

requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.

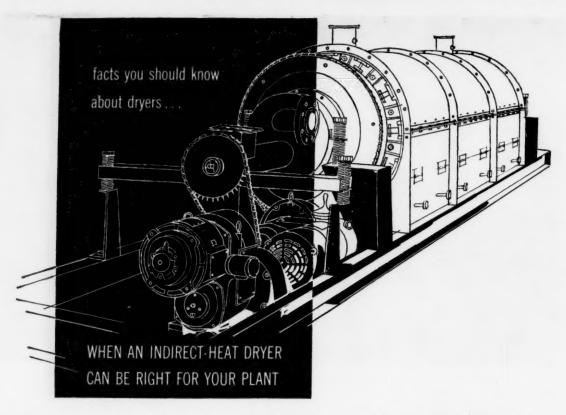
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, make turbine dollars go farther. Send for Bulletin 135 on Coppus Turbine.

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COPPUS "BLUE TURBINES



For over 55 years, Louisville Dryers have been solving industry's drying problems and effecting marked economies. The records of this experience can often be applied to specific cases, possibly yours. For example . . .

- Q. My material is a filter cake, practically all minus 325 mesh, and must not contact furnace gases. It can be heated to 500° F. at least, without injury. What type of dryer would do the job best?
- A. You might consider using a directheat rotary dryer that utilizes clean, heated air as the drying medium—air heated by steam coils or a gas or oil fired heat exchanger. However, this introduces a considerable dust collection problem. Besides, from a standpoint of capacity, it is inefficient as well as from a heatcost standpoint. This makes it unduly expensive. Therefore, a type of indirect-heat rotary dryer is indicated which would greatly reduce both the

dust problem and the heat cost.

- **Q.** What is meant by an indirect-heat rotary dryer?
- A. One in which the material to be dried is warmed by contact with the heated metal surfaces, which in turn are heated by the medium used (usually furnace gases or steam). Those using furnace gases are called "indirect fire dryers". Atmospheric and vacuum drum dryers are examples of steam-heated indirect dryers, but the type in greatest use is the steam tube dryer. This is often referred to as the "Louisville Type" because of the thousands of Louisville Steam Tube Dryers built during the past 55 years.
- Q. How does an indirect-heat dryer minimize the dust problem?
- A. In an indirect-heat dryer, only enough air is admitted to carry off the evaporated moisture. Thus, the air has nothing to do with the heating

of the material. Generally, this low air velocity results in insignificant dust loss.

- **Q.** How does this differ from the operation of a direct-heat dryer?
- A. In direct-heat dryers, the hot air furnishes the heat for drying besides removing the evaporated moisture. The amount needed to supply the necessary heat results in a sufficiently high velocity through the dryer to carry out an excessive amount of fine material particles.
- **Q.** It seems I need an indirect-heat dryer. How can I get competent advice and more information regarding my particular requirements?
- A. The Louisville Dryer engineering staff will be glad to analyze your requirements, arrange for necessary pilot plant tests, and submit an unbiased recommendation accompanied by estimated costs. You incur no obligation by using this service.



LOUISVILLE DRYING MACHINERY UNIT

#### GENERAL AMERICAN TRANSPORTATION CORPORATION

Dryer General Sales Office: 139 So. Fourth Street, Louisville 2, Kentucky Eastern Sales Office: 380 Madison Avenue, New York 17, New York In Canada: Canadian Locomotive Company, Ltd., Kingston, Ontario, Canada General Offices: 135 S. La Salle Street, Chicago 90, Illinois

## PORCELAIN FOR ACID AND ABRASION RESISTANT SURFACES

Because Lapp Chemical Porcelain is chemically inert, it is corrosion resistant and ideally suited for handling acids of all concentrations. It is pure, dense, hard, homogeneous, close-grained and non-porous so there can be no penetration—no crumbling from capillary pressures—no absorption of liquids to contaminate later processing.

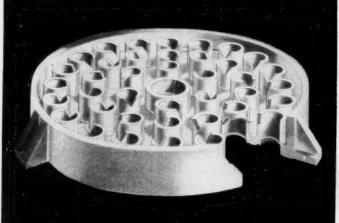
The hardness of Lapp Porcelain proves its worth when used as a "running surface" such as thread guides or rolls for processing synthetic fibers or sheet stock . . . it cannot be scratched and raise a "burr." Since Lapp Porcelain is highly abrasion resistant, it becomes an excellent material for piping to carry off fly-ash; or for handling cement, pigments and abrasive slurries.

Finally, Lapp Porcelain uses low cost raw materials...it can usually be fabricated to customer's specifications for considerable dollar savings. Whether it be special sleeves, nozzles, tubes, pipes and fittings, trays, plates, grates or any other parts where acid and/or abrasion resistant surfaces are required, look to Lapp Chemical Porcelain.

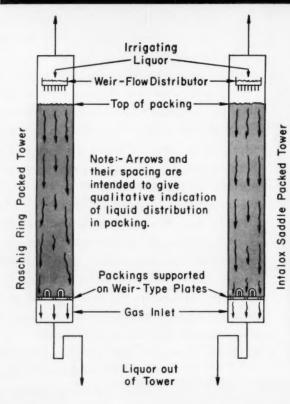
WRITE for description and specifications. Lapp

Insulator Co., Inc., Process Equipment Div., 385 Chestnut St., Le Roy, N. Y.

Lapp CHEMICAL PORCELAIN How to achieve better liquid distribution



# PACKED COLUMNS



Full utilization of packing surface area in a column can only be realized if liquid distribution (both initially and throughout the bed) is such as to provide maximum wetted surface area.

The unique shape of the Intalox Saddle packing permits a thoroughly randomized arrangement of the packed bed, with a virtual absence of pattern packing. Thus, good initial distribution remains intact for greater packed heights than for columns of other packings, notably rings.

Now, U. S. Stoneware makes available two new types of tower distributors, each designed to take full advantage of the better internal distribution of Intalox Saddles. The "Multi-Level" is designed for low liquid rates; the "Weir-Flow"\* for medium-to-high liquid rates. Both distributors assure infinitely better initial liquid distribution than the conventional types of distributors heretofore available. While designed for use with Intalox Saddles, they will improve the distribution characteristics of any packed bed.

\* Made in chemical ceramics, carbon steel, or stainless.

131-F



#### Full details in this NEW Bulletin

Bulletin TA-30 describes these new distributors. Gives data on packing support plates, how to install; when to re-distribute, and other data helpful to designers of packed columns. Free on request. Address Dept. CE 258, U. S. Stoneware, Akron 9, O.



### Chemical Engineering

## Developments

FEB. 10, 1958

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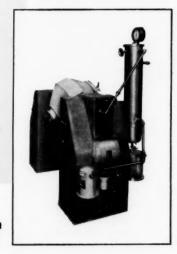
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Fractionator rivals multiplate vacuum tower	76
Two horizontal vessels and interlinked condensers win rosin and fatty acids from crude tall oil—economically—minus the usual trays and packings.	
Tankcars haul dry crystals for less	80
If you buy dry chemicals for use in solution, there are neat savings in store for you in terms of a lower price tag and reduced time and labor for unloading.	
The Goal: Retrieve technical information fast	84
As the amount of technical literature heaped on the industrial public soars with each publishing day, firms are trying out new methods for better data retrieval.	
Strong new plastics competitor	88
New polyvinyl acetal resin—Delrin—complements nylon, says Du Pont, but its potential low price plus superior properties foreshadow very broad applications.	
Now, carriers with built-in pneumatics	94
As long as you're shipping relatively light, granular solids, you'll profit by this new carrier which requires no handling facilities at starting point or terminus.	
Soil Bank bolsters fertilizers for near-future	102
When the Soil Bank bargains with the farmer not to use	
Land "A," he usually tries to get more out of Land "B."  Pesticides are playing a leading role in this attempt.	
1 7 0	



Completely integrated vacuum drying system using P-K Vacuum Tumbler Dryer Blender.

Side view, showing vacuum pump, condenser and related components. Note compact arrangement and short lengths of piping.



### The P-K Vacuum Tumbler Dryer

#### A faster, better way to vacuum-dry heat sensitive materials

The remarkably fast drying action of the P-K Vacuum Tumbler Dryer—a fraction of the time required by conventional methods—is partly accomplished by baffling in the jacket, which circulates the heating medium uniformly around the containing vessel. In addition, rapid generation of vapors produces a scrubbing action on the walls of the blender, improving the heat transfer rate to a marked degree.

These factors, important as they are, do not tell the whole story. The P-K Dryer operates at optimum efficiency when it is part of a completely integrated, factory engineered system, instead of an on-site assembly of component parts and piping—which increases the cost and impairs the attainable benefits. For heat senstive material drying, in a closed system, there must be a perfect balance of jacket

circulation, vapor filter, vapor line, compact piping, vacuum line, vacuum pump and effective controls.

These essential relationships P-K provides, including factory designed supports to house the entire operation. The illustrations show a unit used in P-K's Customer Service Laboratory to pre-test the specific requirements of your formulae. You are urged to use this service without cost or obligation. Similar integrated units can be designed for your needs in capacities from 1 to 150 cubic feet.

Use the coupon to secure Data Sheet No. 1530. Better yet, contact our Customer Pre-test Department for a test if your heat sensitive formulations are difficult to produce rapidly, satisfactorily—and economically.



Executive offices and plant: East Stroudsburg, Pa.

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### Chementator

C. H. CHILTON

### New aniline process gets solid backing

Catalytic hydrogenation of nitrobenzene gets the nod from Du Pont as the modern way to make aniline, displacing the old reduction process using iron borings and HCl.

Du Pont has just begun construction of a new aniline unit at Gibbstown, N. J., which will use the new route. Hydrogen will come via reforming of natural gas. The company is also building new units for ammonia and diphenylamine at the same site.

Two other U.S. aniline producers have also swung over to catalytic hydrogenation. American Cyanamid's new aniline plant at Willow Island, W. Va., is just about ready to go on stream. With a design capacity of 24 million lb./yr., the new unit uses a fluid-bed reactor and a new catalyst. Cyanamid, too, gets its hydrogen from natural gas reforming.

National Aniline has been running a catalytic hydrogenation process at Moundsville, W. Va., for the past four years, doubling its original capacity two years ago. Like Du Pont and Cyanamid, the company declines to identify its catalyst, but a National Aniline patent (U.S. 2,716,135) covering a likely looking process specifies a nickel sulfide and amorphous alumina catalyst. Hydrogen comes from neighboring Solvay's caustic-chlorine plant.

### Molecular sieves split oxygen, argon

First fulfillment of molecular sieves' brightest potential—separation of materials on the basis of molecular size—has just been revealed to *CE* by Linde Co.

For four years Linde has quietly used its synthetic zeolite adsorbent at a major Eastern oxygen plant to remove residual oxygen from argon. Linde says purification via molecular sieves at this site shows cost advantages over conventional techniques for oxygen removal (burning hydrogen or sulfur, passage over hot copper).

Related newsworthy developments:

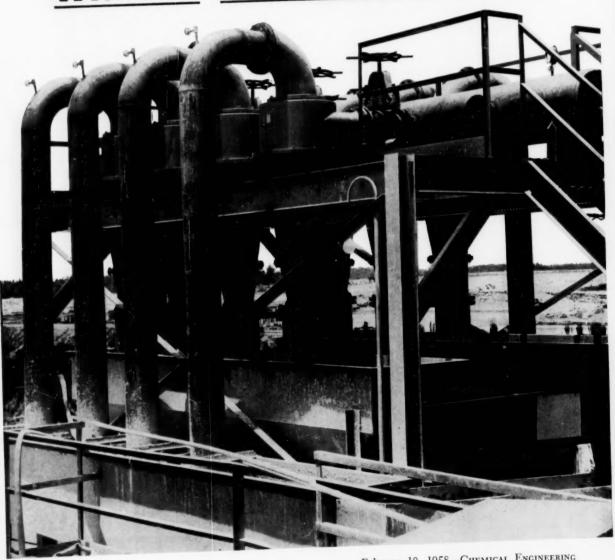
Lurgi has worked out a new method for cracking residual oil in a fluidized bed of sand. Process will go commercial this year in a 40,000-ton/yr. Bayer plant at Leverkusen, Germany.

✓ Zone refining shows promise as technique for making hyperpure organic and inorganic solids. You'll soon be able to buy a low-cost laboratory instrument for zone-refining experiments.

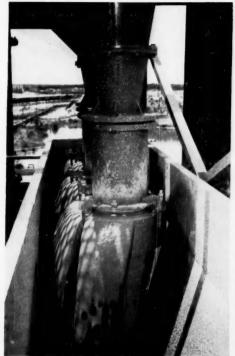
✓ Explosion and fire last month destroyed 25-30% of United Rubber & Chemical's \$8-million plant at Baytown, Tex. Early reports blame explosion on butadiene.

Direct reduction of iron ore in an electric furnace may be commercialized soon, says Strategic-Udy Processes Ltd. New Koppersengineered technique, checked out in pilot plant at Niagara Falls, Ont., consumes as little as 1,300 kwh./ton of metal. NOW \_\_\_ Automatic Control of DorrClone Classifier Operation...

Without Instrumentation!



February 10, 1958—CHEMICAL ENGINEERING



Left—general view of the DorrClone installation on which lests were run.



Latest development in wet cyclone classifiers is an automatic control arrangement that does not require instrumentation. Named the "Siphontrol" underflow control, this new device maintains a reasonably constant underflow density from varying feed solids. Basically it consists of a tail piece extending below the apex valve of the cyclone discharging into a "Saucer" clamped on to this tail piece. The overflow pipe discharge

is also submerged using either a saucer device or manifold.

Here are some typical operating results from DorrClone Classifiers in the field equipped with Saucer controls. These units are desliming phosphate rock at one of the mines in the Florida Pebble Phosphate Field. Successive tests were made at five-day intervals. Note the uniformity of separation despite the wide variation in feed composition.

Equipment — Seven 24" dia. DorrClone Classifiers Control — "Saucer" Underflow Density Controller

Test No.	1			2			3			4		
	Feed	U'flow	O'flow									
Total TPH Solids	601.2	463.4	143.9	325.7	212.1	136.7	302.7	160.4	122.6	785.3	648.7	165.0
TPH + 150 mesh	442.9	449.0	13.5	204.2	202.3	7.0	211.6	148.4	8.0	624.9	615.7	21.5
TPH — 150 mesh	158.3	144.0	130.4	121.5	9.8	129.7	91.1	12.0	114.6	160.4	33.0	143.5
Efficiency												
+150 mesh recovered	97.1%		96.7%		94.9%		96.6%					
-150 mesh eliminated		90.1%			93.0%			90.5%			81.3%	

Tonnages are timed samples and are well within accuracy of method of measurement.

For more information on this new development in wet cyclone techniques, write Dorr-Oliver Inc., Stamford, Connecticut



• Tennessee Gas Transmission uses molecular sieves at Gabe, Ky., to help dry 900 million cu. ft./day of natural gas. Sieves back up silica gel, reduce water content of gas well below former level.

• Sun Oil dries 1 million cu. ft./hr. of hydrogen feed for ammonia synthesis at its Marcus Hook refinery with aid of molecular sieves, gets lower dewpoints and greater

capacity than with alumina alone.

• Lindberg Engineering Co. has developed a unit for removing water and CO<sub>2</sub> from inert-gas-generator nitrogen, using molecular sieves. A Midwest chemical plant is using such a unit instead of a two-stage MEA-absorption, alumina-adsorption process.

### City water supply to come from ocean

Production of fresh water from the sea may get its first big break in the U. S. in a project which would supply Key West, Fla., with the bulk of its city water needs.

City officials right now favor some form of distillation process based on Maxim Silencer Co.'s equipment designs. Singmaster & Breyer, New York, has submitted a proposal for a

detailed engineering study.

Conditions at Key West are made to order for a sea-water distillation plant. Of primary importance is the desperate need for an assured water supply. The city's 53,000 civilian and Navy population now gets its entire supply via a 129-mile, 15-yr.-old, 18-in. pipeline from the Florida mainland. Supply is often inadequate, the steel line is badly rusted and is vulnerable to accidental damage or sabotage. The Navy is going to spend \$1.6 million this year to remove rust and repaint the 29 mi. of exposed sections. Citizens voted down a proposed new \$15-million pipeline four years ago.

On the positive side, Key West already operates a municipal power plant which can furnish the combined economies of low-cost exhaust steam, existing general plant facilities and a going operation. Under such conditions, Singmaster & Breyer believes that a 2-milliongal./day plant at Key West could be built for about half the \$4/daily-gal. figure of S&B's current Aruba project (now nearing completion), and that total conversion cost would be comfortably under Key West's present domestic water rate of \$1/1,000 gal.

Meanwhile, Maxim reports the startups in January of two smaller (16,000 gpd.) land-

based plants, one in Bermuda, the other in the Virgin Islands. These two units are the first to use Maxim's new thermal compression process in which the recycle steam from the evaporator is boosted in pressure by an injector supplied with a small amount of high-pressure steam from an auxiliary oil-fired boiler. A thermal compression plant is easier to operate and maintain than one using mechanical vapor compression, says Maxim.

The Hartford firm also builds submerged surface and flash distillation plants, has supplied many units for shipboard use.

### Kiloton explosion blows cliff to bits

World's biggest man-made nonatomic explosion took place near Promontory Point on Great Salt Lake on January 5, when Morrison-Knudsen Construction Co. set off 2,138,000 lb. of explosives in one giant blast.

Besides shattering Utah's Sabbath stillness, the carefully planned explosion also converted a 300-ft. cliff into 3.6 million cu. yd. of rubble. The broken rock will be used as ballast in construction of a new Southern Pacific causeway across the lake. Rock ballast causeway replaces the old trestle-type crossing.

The blast consumed 1,710,000 lb. of Atlas Powder Co.'s Amocol and 428,000 lb. of RXL 190 dynamite primer. Atlas describes Amocol as a "nitro carbo nitrate" blasting agent, consisting of grained ammonium nitrate (not fertilizer grade) mixed with ground coal (see Chementator, Jan. 27, 1958, p. 56). Cost of explosives was nearly \$300,000.

Smoke and dust from this blast rose 2,000 ft. in the air. The blast was recorded on seismographic instruments hundreds of miles from the site. It broke the previous record for size of blast, set last July 21 on the same project, when 1.7 million lb. of explosives was used to smash 2.5 million cu. yd. of rock.

### Refrig unit supplies vapor to process

A novel tie-in of service refrigeration with process flowsheet is operating successfully at U. S. Steel's new nitrogen products plant at Geneva, Utah.

The refrigeration unit—a 770-ton, twostage centrifugal system supplied by Carrier uses ammonia as refrigerant for three different process uses: Precooling of coke-oven

(Continued on page 74)



### HOW TO "SPEND" SULFURIC -AND HAVE IT, TOO!

Not everyone can do this. But when you can, the dollar savings mount up.

Many uses of sulfuric acid and oleum result in substantial quantities of relatively high-strength, impure acid which present problems of handling and disposal. This is particularly true if you use it as an alkylation catalyst, or for sulfonating white oils, synthetic detergents, etc.

But General Chemical may be able to show you how to "spend" your sulfuric acid and have it, too!

This depends on a number of factors. The acid strength . . . the nature and amounts of contaminants . . . the tonnage

available... the distance of your location from our nearest plant—all have bearing. Generally, spent acids containing 70-80% sulfuric acid, or higher, can be reclaimed if they do not contain impurities harmful to the equipment.

General Chemical has many years of experience in solving spent acid problems of every kind. We will be happy to review the economics of converting your spent acid, and the assistance of our technical service staff is always available to help solve any handling and disposal problems you may have. Just call the nearest General Chemical office listed below.



Basic Chemicals for American Industry

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gas before separation of hydrogen; low-temperature absorption of unsaturated "gumformers" from the gas; final stage of product condensation from ammonia converters.

Ammonia vapor is needed to feed the associated nitric acid and ammonium nitrate units at the Geneva plant. Part of this is obtained by bleeding off the first-stage compressor discharge of the refrigeration unit. (The amount bled is automatically made up with liquid ammonia.) The rest of the vapor feed comes directly from the ammonia plant, where liquid product is similarly evaporated as used for internal process cooling purposes.

As a net result, say Blaw-Knox engineers who designed the plant, the process itself furnishes all the heat needed for ammonia vaporization during normal operation. A standby vaporizer is used only when the synthesis plant is out of service.

### Chemical firms launch missile ventures

Three announcements made within the space of a single week last month underscore the chemical industry's basic position in the fast-moving rocket and missile field:

• Jan. 10—Phillips Petroleum joins with North American Aviation to form Astrodyne, Inc., which will unite activities of the parent companies in the field of solid propellants for rocket engines and aeronautical power units. The new company will have headquarters and operations at Air Force Plant 66 near McGregor, Tex., where Phillips has carried on solid-propellant research, development and manufacturing for the Air Force since 1952. (Watch for a CE Process Flowsheet soon on Phillips' production of solid propellant JATO motors.)

• Jan. 14—Thiokol Chemical Corp. and Callery Chemical Co. team up to develop advanced rocket engines using solid fuels. Callery will make solid HiCal (Chementator, Jan. 13, 1958, p. 73), while Thiokol, pioneer producer of case-bonded, solid-propellant rockets, will build the engines. Development work on new rocket propellants using HiCal boron-based fuels is already under way at Thiokol's Elkton and Redstone Divisions. Another part of the joint effort will deal with development of advanced solid oxidizers to enhance the characteristics of solid HiCal.

• Jan. 16—Stauffer Chemical and Aerojet-General Corp. form a partnership, Stauffer-Aerojet Co., to develop and produce boron compounds for rocket, missile and airplane propulsion. Stauffer is well established in basic raw materials and manufacture of boron chemicals; Aerojet has been working on boron fuels since the early 1940's, when boron was first proposed as an ingredient of high-energy fuels by Fritz Zwicky, then Aerojet's research director. Operations of the new company will be centered at Azusa, Calif.

Also hoping to cash in on the potentially lucrative market for boron trichloride arising from the boron fuels program is a newcomer to the field—Bellevue Laboratories, New York producer of pharmaceuticals. The firm says it has developed "a new and economic process" for production of BCl<sub>s</sub> based on "cheaper raw materials." A company engineer explains that the new process—for which patents have just been applied—uses borax as starting material, instead of the more costly boron carbide said to be used in conventional BCl<sub>s</sub> manufacture.

Significance of such an advantage is hard to fathom, seeing that boron content of BCls is only 9%. Cheap chlorine would seem to be more important. Actually, as a Stauffer expert points out, raw materials costs are of minor significance in today's high price of BCls (\$1.25/lb. in ton lots). More important are the costs of making, purifying and containing the chemical. These costs are sure to drop sharply once BCls gets into high-volume production.

Nonetheless, Bellevue's intentions are backed by a pilot plant now operating at a 100,000-lb./yr. clip. The company says that its new process can be used also to produce other metal chlorides, such as titanium, zirconium and silicon tetrachlorides.

### Slow construction ahead

Kaiser Aluminum & Chemical has slowed down construction of its alumina facilities at Gramercy, La. Alcoa says that it, too, has temporarily halted work on an alumina project and a potline addition at Point Comfort, Tex., and a new smelter at Evansville, Ind. Alcoa's reasons: "Existing high inventories of aluminum coupled with decreasing demand."

(Last month we erroneously identified Kaiser as Wyandotte. We apologize. Our report was not based on rumor and had nothing to do with recent labor troubles in the area, as incorrectly surmised by one of our contemporaries.)

For more on DEVELOPMENTS............76

For industrial finish formulation...

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. . . for applications where very fast evaporation and high solvency are required.

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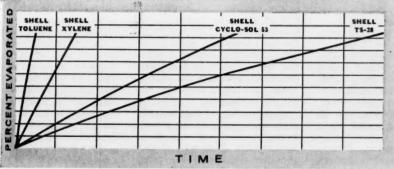
### **SHELL TS-28 SOLVENT**

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These Shell solvents cover a very wide evaporation range. Their individual characteristics satisfy specific requirements in a great variety of formulations.



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#### DEVELOPMENTS ...

### PROCESSES & TECHNOLOGY C. S. CRONAN

### Horizontal Fractionator Looms as Potential

Unique design eliminates trays and packing, reduces pressure drop, cuts unit size and costs.

Adherents of the wintertime "hot-stove league" have a new conversation piece in the novel vacuum-fractionating process just disclosed by Spence & Green Chemical Co., Crosby, Tex.

Aiming at lower cost, highquality fractionation of closeboiling, heat-sensitive liquids, S & G has evolved a system that opens the door to economic processing of 1,000 to 10,000 lb./hr. of feed material.

At Crosby, it's been used to fractionate crude tall oil into rosin and fatty acids at \$75/ton cost, \$30/ton less than steam-vacuum rectification of \$50/ton crude. And it's looked equally good on fractionation of rice and cottonseed oil foots, animal fats and waste glycerine.

► Low Profile—In place of the usual fractionating tower, process uses two horizontal vessels or "lazy towers" and interconnected condensers.

Outstanding feature of this setup is its ability to operate with less than 5 mm. Hg pressure drop. Therefore, it is not necessary to inject steam to hold down the boiling-point temperature of the mixture, as is done commonly in towers where pressure drop may be 40-50 mm.

Without need for steam, material can be fractionated under anhydrous conditions which minimizes corrosion. And with elimination of large volumes of steam, over-all dimensions of equipment can be scaled much smaller.

► Brief Tour of System—Operation of S & G's system centers around two "Quonset-shaped" differential evaporator-condenser vessels.

On the bottom of each unit is a long, flat, rectangular platen heated internally by Dowtherm circulating through longitudinal pipes. Fabricated walls and top of unit are shaped like a semi-cylinder and are jacketed over one section for circulation of condensing coolant. A portion of the top near the highboiling vapor outlet is insulated to prevent condensation of vapors at this point.

The primary evaporator-condenser has vapor outlets at either end. Feed is introduced directly onto the heating platen at a point toward the end where the low-boiling vapors leave. Residue from the distillation drains out at the opposite end of the chamber.

Low-pressure-drop film condensers are tied into the vapor outlets to permit condensation of some or all of the vapor flow, as required.

High-boiling vapor line leads into second fractionator. A single vapor outlet from this vessel feeds into the final condenser. Liquid is drawn off at the opposite end of the chamber.

Entire system is maintained at high vacuum with pump such as a steam jet.

► What Happens Inside?—Metered, preheated feed flows onto the hot platen at a point selected to give the desired separation for the existing feed composition. Spreading out into a 1-mm. film, liquid flows towards the discharge pipe.

Vaporization starts immediately and continues at a uniform rate as the film proceeds downstream. Feed rate, system pressure, platen temperature and distance from entrance to discharge are controlled to produce the total desired evaporation.

As liquid flows downstream, distillate vapors and liquid be-



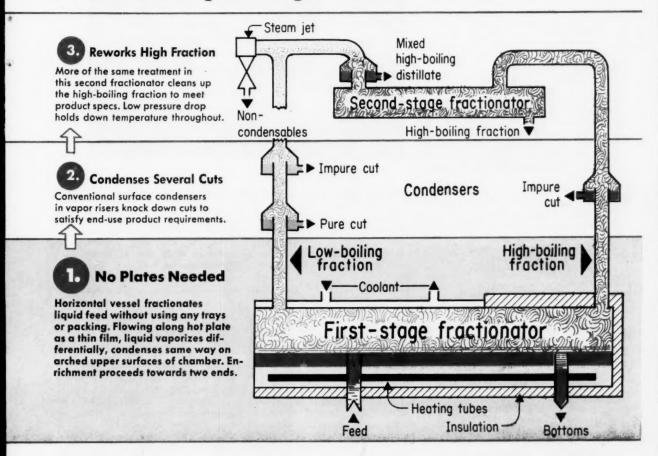
come progressively richer in high-boiling components. And in the opposite or upstream direction, vapors and liquid become progressively leaner in high-boiling components.

Vapor formed toward the upstream end of the chamber tends to flow toward the vapor outlet at that end. During its passage, it condenses differentially on the upper surfaces of the vessel and falls back to the platen, somewhat upstream from its point of vaporization.

Area and temperature of the condensing wall of the vessel can be varied to control rate of condensation.

Through proper manipulation of vaporizing and condensing variables, substantially all vapors formed directly under the

### Rival to Multiplate High-Vacuum Tower



condensing surfaces will flow upstream and all vapors formed under the insulated portion of the vessel will flow downstream. These simultaneous, complementary processes of differential evaporation and condensation produce a high degree of separation. At no time, is vapor in equilibrium with the liquid. ► How It Splits Tall Oil—S & G's Crosby plant has operated extensively on tall oil, using dehydration, deaeration and bleaching steps prior to fractionation.

Running an average crude containing 42% rosin, S & G's primary fractionator splits feed roughly 40-40-20: approximately 40% as fatty acid containing no more than 1-2% rosin, somewhat over 40% as rosin vapor containing about 15% fatty acid, and less than 20% pitch substantially free of fatty or resin acids or thermal decomposition products.

Essentially all of the fatty acid vapors condense in the first vapor-line condenser. A small fraction containing most of the color and odor bodies is allowed to pass through to the second condenser.

If crude has high rosin content, condenser discharge can be restricted to return some fatty-acid condensate to the differential evaporator-condenser, improving the separation of fatty acid.

High-boiling vapors containing approximately 85% rosin which flow out other line drop out 10-20% of their weight in the condenser. In addition to 95% rosin content, this condenser.

sate also carries with it most of the color bodies.

Remaining rosin vapor flows into the secondary fractionator. Repetitive simultaneous differential evaporation and condensation enriches the rosin to a 97% product that is substantially free of unsaponifiables and color bodies. About 20% of feed to this unit discharges as tall-oil distillate containing 25% rosin.

► Vapor-Phase Reactions—Apparatus is amenable to vapor phase modification of the products. Addition of iodine vapors to system disproportionates the rosin almost instantaneously in the vapor phase. Injection of anhydrous alcohol forms fatty acid-methyl esters in the vapor phase: rosin resists esterification.

▶ How About Economics? -S & G has estimated cost of less than \$100,000 for a 5,000 lb./hr. plant based on experience with the present unit handling 1.250 lb./hr. of tall oil. Estimate assumes availability of 1,000-lb./ hr. supply of 125-psi. steam and would include structure, vacuum system, Dowtherm unit, piping and electrical instruments

Cost of this magnitude is no greater than cost of a crude tall-oil plant which every kraft pulp mill must have. Return on the investment would exceed that from a crude plant several times over. And operators of the crude unit could double as operators of the vacuum fractionators.

But equally important in the over-all picture is the fact that S & G's process can be tailored to the needs of either a small or large mill. Economics of the process gives the average-sized pulp mill its first chance to produce its own rosin either for market or for captive paper sizing.

### Basic Oxygen Steel Lists Another Gain

Jones & Laughlin Steel Corp., nation's fourth largest steel producer, has started producing steel via the Brassert basic oxygen steel process (Chem. Eng., Feb. 1956, p. 122). Located at J&L's Aliquippa, Pa., works,



#### Plastic Model Cat Reformer Aids Reactor Design

Plastic scale model catalytic reformer, above, filled with a coarse, granular material, (not catalyst), gives engineering design data at Sun Oil Co.'s new

\$24-million research and development laboratories at Marcus Hook, Pa. Engineers use the model to study flow of gases through reactor bed.

the 750,000-ton/yr. installation represents the first venture by a major steel producer into basic

oxygen process.

Compared with open hearth operation. Brassert process requires about half the capital investment per ton of capacity, claims lower operating cost and high-purity steel. But at present, J&L views basic oxygen process as an adjunct to open hearth operation rather than as a replace-

J&L's plant consists of two steel furnaces and two oxygen generating units, each turning out 115 tons/day of 99.5% oxygen. Steel-making section was engineered and built by Kaiser Engineers while Air Products, Inc., handled design and construction of oxygen facilities.

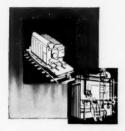
The two cylindrical furnaces, resembling Bessemer converters, have working linings of tardolomite brick. One furnace is in production while the other is being relined. Furnaces produce about 54 tons steel per 37-min. heat.

Furnaces are charged with molten iron and scrap-in about a 4:1 ratio-and slag-forming materials. Then a water-cooled lance is lowered to surface of the charge and oxygen at 100-150 psi, directed at the bath, 2,000 cu. ft. oxygen are needed for every ton of steel produced.

Blast of oxygen triggers an instantaneous reaction, forming FeO which is then reduced by carbon in the charge. Released carbon monoxide starts a vigorous boiling which reaches all parts of the charge. In central reaction zone, temperature is close to boiling point of iron (9,572 F.) which enhances solubility of oxygen and accelerates diffusion through the bath.

Conclusion of the reaction is marked by a distinct drop in the flame at furnace mouth. Resulting steel is low in nitrogen, sulfur and phosphorous and is quite

ductile.



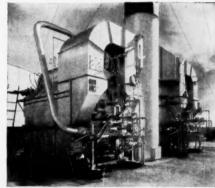
### HEAT ENGINEERING by FW

# extends Central Station Reliability to Standard INDUSTRIAL and

### **PACKAGED UNITS**

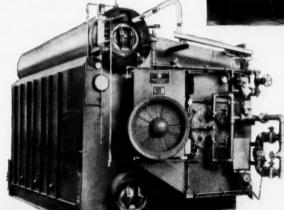
PACKAGED STEAM GENERATORS of the water-tube type were introduced by Foster Wheeler in 1940 — combining in a single, compact, shop-assembled unit, all the necessary facilities for the dependable and economical generation of industrial steam. Continual research and development have resulted in further improvements in design and construction, and today the FW line of Packaged Steam Generators, in capacities from 10,000 to 60,000 lb/hr, represents the last

word in modern steam plant design, reflecting over half a century of service to the power generation industry. Features include 36" steam drum and 24" water drum, staggered boiler tubes, closely spaced waterwall tubes, water-cooled target wall, and wide choice of burners and controls.

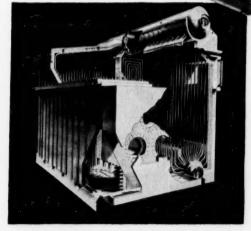


Above: Two FW packaged boilers — the first ever offered to industry — were installed for oil field drilling operations in 1940. They are still in service, delivering low-cost steam.

Left: New Foster Wheeler series AG-100 Packaged Steam Generator.



Cutaway view of typical FW Standard Steam Generator.

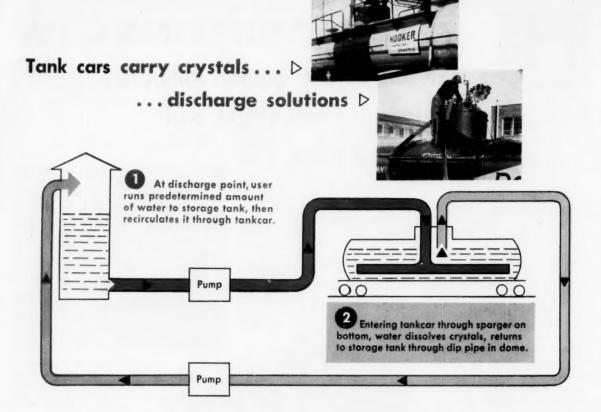


STANDARD PRE-ENGINEERED UNITS by Foster Wheeler offer all the advantages and economies of standardization for larger industrial steam generators of from 50,000 lb/hr to 450,000 lb/hr capacity. The new FW line of "SC" and "SD" standard units is heat engineered to the same standards of dependability and performance which have made Foster Wheeler steam generators first choice in many of the leading central station plants throughout the country. Features include completely water cooled walls, efficient firing arrangement, fully drainable superheater, high steam purity, unrestricted circulation, pressure-tight construction and minimum refractory baffling. For further details, send for Bulletin B-55-4.

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### **Tankcars Cut Shipping Costs for Crystals**

Look for tankcars to win an increasing share of dry crystal haulage. Bulk prices and solution unloading trim user costs.

Dry solids have quietly preempted some of the nation's railroad tankcar capacity, appear certain to widen their foothold within the near future. Reasons are straightforward lower price tag for purchaser of chemicals and reduced time and labor for unloading. Only requisites seem to be a customer who purchases dry chemical material, then uses it in solution.

▶ On Receiving End—Within recent months, L. Sonneborn Sons, Inc., received its first tankcar shipment of dry calcium chloride at its new Nutley, N. J., unloading facility. Designed to dissolve the calcium chloride right in the tankcar and unload it as solution, this \$12,000 facility saved \$4,000 on raw material cost alone during its first four months of operation.

At its Stamford, Conn., plant,

C. H. Phillips Div., Sterling Drug Co., now receives two or three 80,000-lb. tankcars/wk. of technical grade magnesium sulfate crystals which are unloaded as solution.

Of longer duration is Wah Chang's combined rail-barge shipment of calcium chloride to its tungsten operation at Glen Cove, Long Island, N. Y. Crystals received by tankcar at mainland unloading station are transshipped as solution in barges to the Long Island plant.

As much as 10 years ago, coal mines began receiving solid calcium chloride by tank car. Coal discharging into open hopper cars from the washeries is sprayed with the solution to keep it from freezing into a solid mass under winter conditions.

Recently, tankcar calcium chloride has proven useful in servicing highway requirements. Application of the liquid material on highways to lay dust and consolidate the soil is making inroads on the older method of spreading dry flakes or pellets of calcium chloride.

Don Shipping End—Dow Chemical Co. tankcars haul calcium chloride flakes or pellets, magnesium chloride and magnesium sulfate. And Dow is frank to admit that this type of shipment may win acceptance for other chemicals in its line.

Columbia-Southern Chemical Corp. tankcars also haul calcium chloride and, to a limited extent, other solids. Solvay Process Div. is prepared to offer this service for calcium chloride, has one customer buying soda ash in tankcars.

Hooker Electrochemical Co. ships sodium chlorate by tank car. Virtually all sodium chlo-



CHEMICAL ENGINEERING-February 10, 1958

rate, Hooker's and others, now travels in tankcars to pulp mills manufacturing chlorine dioxide for bleaching. The same holds true for shipments to manufacturers of chlorate-based cotton defoliants and weed killers for railroad rights-of-way.

► What Are Benefits?—Sonneborn's experience with a typical unloading setup merits attention. Formerly, Sonneborn handled 10,000 bags of calcium chloride during a four-month production season. Just to mix one batch of solution containing 7,000 lb. of calcium chloride required 3 hr. time plus 6 manhours of labor. Then, solution had to settle for 24 hr. before

Now, ten times that amount. or the 65,000 to 80,000 lb. contained in a tankcar, is both unloaded and mixed in 4.5 hr. Labor totals only 5 manhours.

From the shipper's point of view, the method is advantageous because there are fewer packages to warehouse, load and weigh. What he saves in packaging and handling costs can be applied to lowering price to the customer.

How Unloading Works-Sonneborn's installation stores solution in two 27,000-gal, tanks. Pipes and hoses connect tanks to tankcars through a duplex valve manifold and two 4x3 centrifugal pumps. An additional pump transfers finished solution to processing tanks.

Unloading operation starts when operator runs a predetermined amount of water into a storage tank, sufficient to produce solution strength slightly greater than needed. Dilution to final strength comes from tank-

car washings.

From the storage tank, water passes into the tankcar through a permanently mounted sparger pipe consisting of a riser extending through the dome and a perforated horizontal which extends along the bottom of the car. Liquor formed by dissolution of the crystals in water then circulates back to the storage tank through dip pipe and strainer suspended from the dome.

Solution continues to circulate until all calcium chloride is dissolved. Pump flow is balanced automatically by a float control devised by Sonneborn. Signals from two limit switches on the float suspended in the tankcar start and stop the incoming flow.

When solution is complete, incoming flow is stopped and the car begins to unload. When car is almost empty, discharge

pump is stopped.

At this point, there is a frothy scum which remains floating on the liquid in the bottom of the car. In this froth are solid impurities which rise to the top during dissolution and stay there a few hours before sinking.

By never dropping the liquid level below the strainer opening on the outlet dip pipe, Sonneborn keeps these impurities from entering its storage tanks. Residual calcium chloride in heel liquor is recovered by alternately adding several hundred gallons of wash water and pumping down to the strainer several times. By leaving impurities in tankcar, Sonneborn avoided purchasing a \$10,000 filter.

### Atomic Amplifier May Ease Runaway Worries

Atomic power reactors may not need to "go critical" in the future. Not if the neutron amplifier of New York University's Lyle Borst wins commercial approval.

Main advantage of this development is the increased safety it would give to atomic power plants. Reactors could operate at subcritical level, eliminating runaway danger and thus quieting some worries among the populace about planned power

plants near cities.

Called the convergatron, the cell amplifies neutrons in a manner analagous to a vacuum tube. It consists of three sections: a pure neutron moderator (e.g., water or graphite), atomic fuel (unenriched U-238) and a thermal neutron barrier such as cadmium.

Several of these cells are placed in series; atomic fuel is activated by thermal neutrons from previous unit. Each zone operates at a higher power while depending on the preceding stage for its excitation, so no part of system contains a full chain reaction.

Entire reactor can be shut off by simply removing the initial

#### Convention Calendar

National Society of Professional Engineers, spring meeting, Michigan State University, East Lansing, Mich., Feb. 13-15.

Technical Assn. of the Pulp & Paper Industry, 43rd annual meeting, Commodore Hotel, New York, N. Y., Feb. 17-20.

National Council for Stream Improvement, annual meeting, Waldorf-Astoria Hotel, New York, N. Y., Feb. 17-20.

Regional Conferences on Utilization of Engineers, under auspices of President's Committee on Scientists and Engineers, Drexel Institute, Philadelphia, Pa., Feb. 19.

American Institute of Chemical Engineers, Twin Cities chapter, all-day technical meeting, Pick-Nicollet Hotel, Minne-apolis, Minn., Feb. 20.

Chemical Institute of Canada, 12th divisional conference, Protective Coatings Subject Div., Toronto, Ont. (Feb. 20) and Montreal, Que., (Feb. 21), Feb. 20-21.

American Society of Mechanical Engineers, Gas Turbine Power Div., conference and exhibit, Shoreham Hotel, Washington, D. C., March 3-6.

American Society of Mechanical Engineers, Lubrication Div., role of viscosity in lubrication, 150 E. 42 St., New York, N. Y., March 10-11.

Nuclear Congress and Trade Show, International Amphitheatre, Chicago, Ill., March

National Assn. of Corrosion Engineers, national meeting, Civic Auditorium, San Francisco, Calif., March 17-21.

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DAMAGE-RESISTING Acme thread. If you've struggled with "banged-up" threads, you'll appreciate this feature. It's always a breeze to put on and ( take off tanks for installation, inspection or maintenance.

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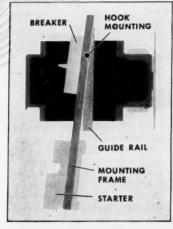
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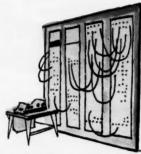
### ... use manual indexing

Code on Uniterm cards refers to specific source material related to the subject heads on these same Uniterm cards.



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Punched cards of various types offer wide versatility to lead literature searchers to the information they are seeking.



### .. are eyeing computers

Hope of future in searching rapidly mounting volume of technical literature lies in mechanized computers.

### Searchers Seek to Open Literature Logjam

WHAT'S to be done about utilizing the rising flood of valuable printed technical and business information?

National Science Foundation estimates output of technical literature is swelling at a rate that closely parallels the 12%/yr. growth rate of scientific research.

Chemical Abstracts expects its Decennial Index, scheduled for publication over the next 4 yr., to take nineteen 1,200-page volumes, three more than the combined total of the three previous Decennial Indexes.

► What's Being Done—U. S. industry already is trying out a variety of new methods to speed up retrieval of recorded data.

National Science Foundation is about to publish a report on how some 25 big U. S. companies handle technical information. While the report won't evaluate the systems, it will describe fully file sizes, rate of growth of data and the number of personnel needed to operate them.

Some outfits are reorganizing information services to include highly skilled technical person-

nel in newly setup technical information divisions. This group numbers Ethyl Corp., Phillips Petroleum, Esso Research & Engineering and Smith, Kline & French—to name a few.

Other firms are putting more stock in better tools for their library documentation and retrieval services. Methods sweep the gamut from rather simple and inexpensive coordinate card indexing systems to complex and costly machine searching systems. The latter's big selling point is the promise of more finely discerned information.

Here's how some organizations have "shopped around" to find the best system for their purposes.

Start With Simplest—Starting off with one of the simplest systems, let's look at one in use at the Summit, N. J., research laboratories of Celanese Corp of America. Here, A. F. Caprio, original patent holder on tricresyl phosphate, has a smoothrunning technical information service, thanks to the Uniterm system of retrieval. Celanese prefers the system because it involves neither costly equip-

ment nor technical personnel to operate it.

Largely a manual process developed by Dr. Mortimer Taube, Documentation, Inc., Washington, D. C., Uniterm keeps track of information in the patent, intra-company report and general literature libraries at Celapses.

System hinges on use of key words, phrases, proper names, trade marks, arabic numerals, dates, or project and contract numbers which describe ideas or concepts embodied in the documents. Each of these Uniterms is typed as the heading on individual cards, which are then filed alphabetically.

Each new document is assigned an accession or serial number. Uniterms are chosen which best identify the areas covered by document. To each Uniterm card is added the document accession number. To permit easy scanning, these numbers are arranged so that the last digit coincides with a digit column-heading from 1 to 9.

To locate source material on a given subject, clerk scans Uniterm cards related to that



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subject. Accession numbers appearing commonly on more than one of these cards most likely denote documents containing desired source material.

▶ Punched Cards — Somewhat mechanized is Ethyl Corp.'s system of retrieving information on fuel and lubricant additives from internal data, patents, periodicals and other sources by use of an exhaustive file of machine-sorted punched cards.

Cards are punched with code that gives appropriate bibliographic information (accession numbers), chemical structure of the additives, use functions of the additives and the petroleum products in which they are employed.

Other cards are punched with the names of authors (or patentees) and organizations (or

assignees).

Abstracts of the original references, typed on 5 x 8-in. vellum slips, are filed by accession numbers identical to those assigned to the original documents. Ozalid working copies of these abstracts are kept in a duplicate file. Additional Ozalid copies can be made from the original yellum abstracts.

Ethyl's search procedure uses a Remington Rand 320 automatic sorter to separate out cards pertinent to information sought for a given problem. Similar systems that are more efficient, but also more expensive include the Remington Rand collator and the IBM 101 sorter. Ethyl's Ben Weil feels that Ethyl cannot economically justify at this time the equipment refinements offered by these newer, more-expensive machines.

▶ Searching Selector — Still more mechanized is a "searching selector" designed and constructed by Western Reserve University's Center for Documentation Research in Cleveland. Under the direction of James W. Perry, WRU is piloting a mechanized searching service with this machine for the American Society of Metals on approximately 25,000 important metallurgical papers.

WRU's system uses special techniques to facilitate machine searching. First, document is abstracted in telegraphic form which easily can be converted into code (encoding). Abstracts are encoded semi-automatically by commercially available IBM equipment set up to function as an 8,000-term automatic dictionary.

An operator then translates the encoded abstract onto an eight-channel punched tape to provide the "library" which will be searched by the selector.

To retrieve information from this tape in response to a question, the searcher first reduces the question to a logical form and code which can be wired into the selector's plugboard to produce an electric circuit analogous to coded question.

Then a Flexowriter connected to the selector "reads" the library on the eight-channel punched tape. Each time that punched symbols on the tape conform to the code wired into the selector, the Flexowriter types out a coded reference. Entire tape takes approximately 1 min. to read.

Compared to most computers, WRU's selector is slow. On the other hand, it costs much less. Eventually, WRU hopes to boost speed by a factor of 10° and increase the code dictionary to

some 30,000 terms.

▶ High-Speed Computers — Going all the way with mechanization, you can get one of the many available computers to do most of your searching in a flash, completing up to 5,000 complete searches per minute. Included in this category are the IBM 700 series and the Remington Rand Univac models.

Dow Chemical's Ascher Opler says that his firm has carried out computer searching by renting time on a number of IBM machines for a few minutes each week—on an experimental hasis.

Machines rent for about \$7-8/min. So, for less than \$100/mo. the computers breeze through work which otherwise might cost the firm far more in time lost waiting to do work and in money for paying idle staff.

► What's Ahead?—People like Ascher Opler hold that you can wire any machine to handle almost any problem, if you know how. "Trouble is," Opler says, "most of industry just isn't acquainted with the highly developed equipment already available."

Others, though, like Mrs. Mary Sullivan, Dravo Corp.'s librarian, view the situation differently. "So far," says she, "we honestly haven't come up with machines efficient enough to warrant a switch from what we now have."

But, no matter who's right about the readiness (efficiency) of today's equipment, or its apocryphal future, the fact remains that something's got to be done and soon. After all, valuable technical information isn't really so valuable if you can't find it when you need it.

### News Briefs

Ultrapure silicon: Merck & Co. is building facilities costing more than \$5 million at Danville, Pa., for production of ultrapure silicon used in transistors and rectifiers. Silicon will be produced under special license agreement with Siemens & Halske and Siemens-Schuckertwerke. Onstream date is Jan. 1958.

Silver-base control rods: Westinghouse, at its Bettis atomic power division, Pittsburgh, Pa., has developed a new silver-base alloy which is claimed to significantly reduce manufacturing costs for water-cooled atomic reactors. While somewhat inferior to hafnium in mechanical and physical requirements, says Westinghouse, the alloy boasts relatively low cost and ready availability.

Hydrofluoric acid: Stauffer Chemical Co. has announced plans to build a large hydrofluoric acid plant at Louisville, Ky. Construction will begin around mid-year.

Phthalate plasticizers: Kolker Chemical Corp. is now producing dimethyl and diethyl phthalates at its Newark, N. J., plant. Plant has capacity of 50 million lb./yr. of plasticizers, including phthalates, phosphates and epoxies.



EVER-TITE COUPLING CO. INC., 254 WEST 54TH STREET, NEW YORK 19, N. Y.

DEVELOPMENTS ...

### CHEMICAL PRODUCTS EDITED BY FRANCES ARNE

### **New Plastic Combines Outstanding Properties**



Strong and Resilient
Approaches aluminum in strength; like steel, bends if forced, recovers perfectly.



Abrasion Resistance Superior to most other hard plastics except nylon.



Solvent Resistance Excels all other thermoplastics except fluorocarbons.



Dimensional Stability
When completely immersed in water, expands only 4% — less than nylon.



Deformation Recovery When elongated 10% for 10 min. at 150 F., returns to 1.5% after load removal

### Polyvinyl Acetal Bids for Many Jobs

Called Delrin, new formaldehyde-based long-chain polymer may vie with nylon for gear applications, with butyrate for phones, melamine for dishes.

In many of its properties, a new polyvinyl acetal resin is very similar to nylon. But its properties resist unusual surrounding conditions better than nylon's. Its moisture absorption is much less and it has greater retention of stiffness and strength at high temperatures and humidities, in contact with solvents, and under prolonged stress.

Called Delrin, the tough, rigid

material is envisioned by manufacturer Du Pont as a complement to nylon in properties and applications. Company believes its Zytel nylon would be the preferred material where a higher melting point, higher service temperature, the ultimate in abrasion resistance and the maximum in toughness are necessary, e.g. for bearings. The new polyvinyl acetal would be chosen where higher stiffness,

maximum fatigue endurance strength, lower creep, better stain resistance and better dimensional stability are required, e.g. for gears.

Price, too, is expected to be in the same range as nylon's. However, the long-range picture may hold a marked downturn, which would set Delrin's application sights even wider. It is made by polymerization of formaldehyde, one of the lowest cost monomers used in plastics. And its manufacture takes much fewer process steps than nylon's.

Product is thermoplastic, can be molded or extruded in the more economical! handles faster, easier!



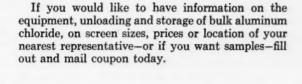
# NOW IN <u>BULK!</u> SOLVAY Anhydrous ALUMINUM CHLORIDE

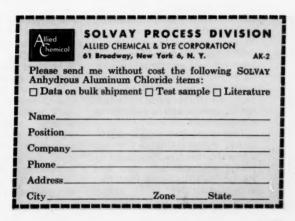
Introducing a SOLVAY original — delivery of anhydrous aluminum chloride by bulk trailer . . . designed by SOLVAY engineers to better serve quantity users.

The shipment, unloading and storage of bulk aluminum chloride means savings all along the line. Savings in time . . . labor . . . and money—through the elimination of heavy, individual drums with their special handling, unloading and storage problems. All forms of Solvay Aluminum Chloride are available for bulk shipment.

Sodium Nitrite • Potassium Carbonate
Caustic Soda • Calcium Chloride • Chlorine
Sodium Bicarbonate • Ammonium Chloride
Caustic Potash • Chloroform • Vinyl Chloride
Methylene Chloride • Para-dichlorobenzene
Methyl Chloride • Cleaning Compounds • Soda
Ash • Hydrogen Peroxide • Aluminum Chloride
Ammonium Bicarbonate • Carbon Tetrachloride
Monochlorobenzene • Mutual Chromium Chemicals
Ortho-dichlorobenzene • Snowflake® Crystals

SOLVAY branch offices and dealers are located in major centers from coast to coast.





conventional manner. Its chain structure unit is  $-CH_2O-$ . It is linear, highly crystalline and

high melting.

Mechanically, Delrin is strong, tough, exceptionally high in stiffness. Measurements of weight loss in various abrasion tests indicate that it is inferior to nylon in this respect but superior to most other hard plastics. It retains almost onefourth of its room-temperature stiffness at 250 F. and has very high heat-distortion temperatures. Polyacetal has good strain recovery. Even at 150 F. and 100% R.H., when loaded to 10% elongation it returns to 1.5% elongation in the first minute after the load is removed and eventually recovers almost completely.

Thermal properties are about equal to those of other thermoplastics and compare closely with those of nylon and butyrate. Its electrical properties are good but not extraordinary.

The new plastic has greater solvent resistance than any thermoplastics except the fluorocarbons. In extreme contrast to the behavior of many polymers, polyacetal has demonstrated excellent resistance to crazing or stress-cracking by organic solvents.

It's resistant to staining by coffee, tea, vegetable dyes, lemon juice, is non-toxic and it is safe for use in eating utensils.

Permeability of polyacetal to many organics is only a fraction of that of polyethylene, but it is much more permeable to water vapor than polyethylene.

water vapor than polyethylene. This blend of properties is expected to open up many uses in the automotive, plumbing, appliance, packaging, hardware and industrial fields, as well as in consumer products. It already has performed well in tests as engine timing gears, valve parts, dishwasher components, thin-walled bottles, bearings, sprinkler parts, football cleats, combs and a number of other items.

List of product weaknesses is short: vulnerability to UV and mineral acids, its reluctance to accept adhesives and inks, and its flammability.—Du Pont Co., Wilmington, Del. 88A

### Page number is also Reader Service Code Number

Polyvinyl acetal uses to range widely	88A
Alkyd emulsion affords water-thinned paint benefits	90A
Polyethylenes: a low-melt and a medium density variety	90B
Dacron makes blimp envelopes stronger and lighter	92A
Rb and Cs chemicals in quantity at reduced prices	92B
Surfactant for heavy duty liquid steam cleaning	92C
2-4-D now used as growth stimulant	92D
Germicide for food processing works in hard water	92E
Quercetin availability heralds new line of bark derivatives	92F

#### Paint Vehicle

Alkyd emulsion for waterthinned gloss architectural finishes.

A new alkyd emulsion, designated 1505 Synthemul, is said to offer better adhesion, better water resistance and much greater mar resistance than any available vehicle for water-thinned gloss architectural finishes (*Chem. Eng.*, Aug. 1957, p. 182).

Product aims at combining the best features of water-thinned paints (ease and speed of application, absence of odor and fire hazard, rapid drying) with those of the solvent-thinned variety.

Paints made with it are expected to cost less because a lower percentage of vehicle can be used in the formula without loss of gloss, due to the new emulsion's greater pigment binding capacity. Good gloss can be obtained with pigment volume concentrations of 16 to 27%, compared with maximum concentrations of 8 to 13% for previously-available emulsions. The corresponding increase in the amount of pigment in the formula gives more hiding power.

Company's earlier alkyd emulsion aimed at industrial users, 1504 Synthemul, is also said to produce water-thinned paints which incorporate advantages of solvent-thinned products. However, the new 1505 has special appeal for architectural finishes on the basis of acceptable colors, including white. It can be

used by itself or, for improved color retention and speed of dry, it may be used in combination with vinyl acetate emulsions.—
Reichhold Chemicals, Inc.,
White Plains, N. Y. 90A

#### Two Polyethylenes

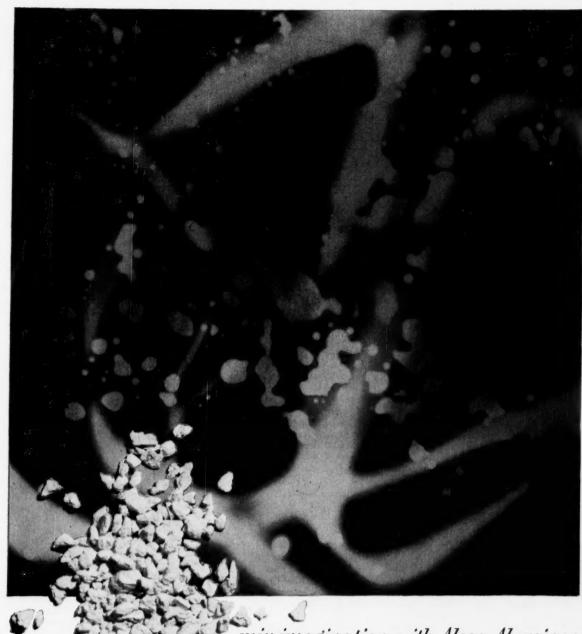
A low-melt and a mediumdensity variety.

A new polyethylene resin identified as Epolene C possesses many of the properties generally associated with plastic grade resins and yet can be handled much like a moderate to high melting point wax.

At 300 F. the viscosity of the new resin is 8,000 cps. The addition of 25% paraffin, with which it is completely compatible, reduces the viscosity to only 1,300 cps. at this temperature.

Three general areas of use are foreseen: As a melt casting, the new material can be employed with or without the addition of coloring agents to form relatively hard, tough cast or slush molded objects. As a hot melt, it can be applied to virtually all types of paper, comparing favorably with coatings achieved by the extrusion of plastic grade polyethylene. As a paper coating material it can be handled in conventional wax coating machines with only slight modifications including provisions for higher temperatures in the fountain.

The same manufacturer has



### mix imagination with Alcoa Aluminas

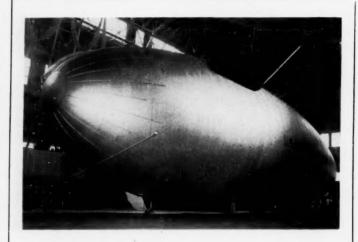
and dry gases, liquids, vapors or solids drier than ever before! Mix imagination and engineering with Alcoa® Activated Alumina in your drying operation; this "old reliable" among commercial desiccants has been thoroughly proved in service. Count on it to achieve the lowest dew points you require. Drying costs are remarkably low because Alcoa Activated Alumina can be saturated and reactivated indefinitely without effective loss of drying capacity. If you have a dehydration problem and you haven't tried Alcoa Activated Alumina, you should—at once. For

full information and samples contact the local Alcoa Sales Office or write ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-B Alcoa Building, Pittsburgh 19, Pa.





For finer products . . . let Alcoa add new directions to your creative thinking!



### Synthetic Skin for Blimp, Stronger and Lighter

In a recent test, naval officers evaluated the performance of an anti-submarine patrol blimp with a skin of coated Dacron polyester fiber. Four months of trial flights showed that the fabric reduced helium loss to half of that in natural fiber envelopes now used.

The final envelope material comprised two layers of fabric of Dacron combined with an inside coating of neoprene, a binding layer of neoprene and an outside coating of aluminized Hypalon synthetic rubber. Total weight: 151 oz./sq. yd. Reduction in weight is enough to permit carrying of additional equipment or more fuel for prolonged flights .- Du Pont Co., Wilmington, Del. 92A

introduced a new mediumdensity Tenite Polyethylene, designated as series 100. As compared to low density conventional type polyethylene, use of 100 Tenite means greater stiffness, higher heat resistance, and greater resistance to abrasion in molded products. It avoids the limpness of some items with thin walls molded from conventional type polyethylene. - Eastman Chemical Products, Inc., New York, N. Y.

#### Rb and Cs Chemicals

Produced in quantity; price greatly reduced.

Carbonate, sulfate, chloride and fluoride compounds of both cesium and rubidium, priced at \$13 to \$27.50/lb., have just become available in quantity. Current prices for these compounds range between \$100 and \$400/lb.

This is the first time rubidium salts have been made in sizable quantity in the United States. World supply has amounted to only a few hundred pounds per vear.

Cesium and rubidium are the most reactive of the alkali metals. Both chemicals are under study for use in atomic energy applications and in ion propulsion research. Present uses include the manufacture of specialty glass, in photocells used in automatic controls and in chemical processes. They also find application in electrical and radio engineering, manufacturing of vacuum tubes and X-ray equipment, certain medical uses and specialized optical applications.—American Potash & Chemical Corp., Los Angeles, Calif.

#### Briefs

Surfactant for the formulation of heavy duty liquid steam cleaning compounds is offered exclusively to the chemical processing industry. Called Miranol CM Conc., it has high tolerances for electrolytes and alkalies and it compounds with lower alkalinity than the customary powdered products.-Miranol Chemical Co., 277 Coit St., Irvington, N. J.

2-4-D as growth stimulant instead of weed killer is finding success in the rubber industry. Tested in Malaya and Indonesia, it has raised latex yields of trees as much as 25 to 40%.-U. S. Rubber Co., 1230 Ave. of the Americas, New York, N. Y.

Quarternary ammonium germicide, Hyamine 3500, for sanitizing dairy, restaurant and food processing equipment is now available in commercial quantities. Liquid sanitizers which are effective in waters of 0 to 550 ppm. hardness can be formulated with it. Chemically, it is n-alkyl (C14-C12-C16) dimethyl benzyl ammonium chloride.-Rohm & Haas Co., Philadelphia, Pa.

Quercetin, now available in pilot plant quantities, is the first of a new line of bark derivatives to be marketed as a fine chemical. Like its glycoside, rutin, quercetin is used in pharmaceutical preparations of the bioflavonoid type for the prevention of capillary fault.-Weyerhaeuser Timber Co., Tacoma, Wash.

## about any item in this department, circle its code number on the service postcard inside the back cover For More Information . . .

**Reader Service** 

# How to cut lubricant costs up to 90% — and increase production!

Large and small plants in many industries are making important maintenance savings while actually boosting machine output—with Alemite Oil-Mist Automatic Lubrication.

The Oil-Mist system atomizes oil into air-borne particles,

carries them through tubing to all lubrication points and bathes every moving surface with a cool film of clean lubricant while machines operate. It provides constant, uniform, completely automatic lubrication to a few or to hundreds of bearings. Accurate and foolproof, Oil-Mist eliminates guesswork.

Three types of Oil-Mist fittings apply lubricant in the form required. Either a mist fitting or a condensing fitting or a spray fitting, is used to lubricate any lubrication point.

can be overlooked or over-lubricated.

An Oil-Mist system can be applied to any new or installed machine. Find out in detail how it cuts costs, reduces man-hours and machine downtime, extends bearing life, and increases production.

Write Alemite, Dept. J-28, 1850 Diversey Parkway, Chicago 14, Illinois.

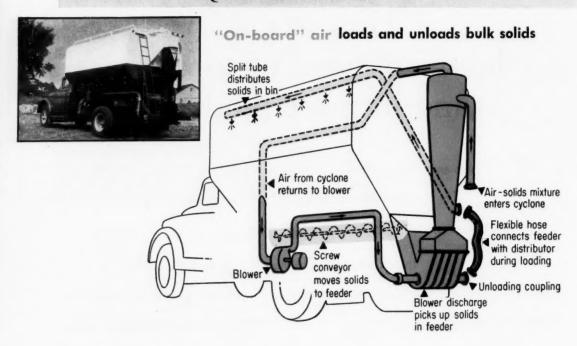
Makers of these automatic centralized lubrication systems : Oil Mist · Accumatic · Accumite

1850 Diversey Parkway, Chicago 14, Illinois



DEVELOPMENTS ...

### PROCESS EQUIPMENT EDITED BY C. S. CRONAN



### **Handling System Brightens Truck Future**

With an integral solids-handling system, bulk truck now offers complete bin-to-bin transfer of shipment.

To aid you in shipping bulk quantities of relatively light, granular solids, Sprout Waldron has developed a line of bulk carriers with built-in pneumatic handling systems.

Loading themselves from either storage bins or railroad cars, these trucks can proceed to their destination and unload directly into bins or other trucks.

No handling facilities are needed at either the starting point or terminus of the trip. Only an access line and internal piping are required on the storage bins at each point. The truck provides the connecting link to move the solids unaided from one to the other.

► Opens Way for Bulk—With S-W's pneumatic system, both

shipper and receiver benefit without incurring handicaps.

Of course, buying and shipping in bulk is cheaper. And pneumatic handling saves time and labor, avoids contamination, minimizes dusting. But it's the S-W adaptation of pneumatic handling that's reported to open the way for an upsurge in bulk trucking of dry industrial solids.

No longer does a user face the prospect of having to install special, costly equipment so that he may receive bulk shipments. And it removes from truck owners the burden of having to scrap standard haulers once they have established bulk deliveries to some of their customers.

▶ Peanuts to Cement - Sprout

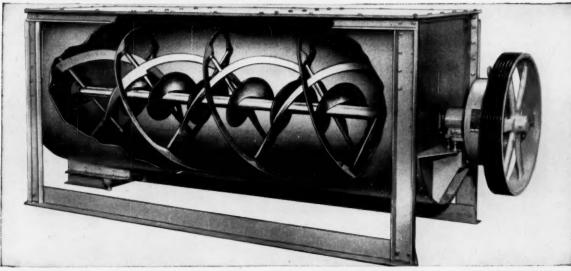
Waldron's bulk trucks have handled materials ranging from peanut shells to cement, spanning densities from 10 to 95 lb./cu. ft. and individual particle sizes from the micron range up to \( \frac{1}{2} \)- by 1\( \frac{1}{2} \)-in, cattle cubes.

The feed industry, which gave much impetus to development of S-W's new line, already uses bulk delivery to reduce handling costs. Over-all savings as high as 22¢/100-lb. bag of feed have been reported.

Bulk flour costs 1¢/lb. less to deliver than sacks. Big bakeries, canneries and industrial users of sugar have quoted average savings of 4%. Another industrial shipper finds that bulk delivery dropped costs to one-third of previous values.

► You Blow In Here—All selfloading models operate much the same, despite differences between models engendered by buyer requirements.





### PRECISION MIXING WITH **NEW TRIPLE ACTION MIXER**

Strong-Scott Mixer Offers Uniform Blending and Mixing in 2 to 7 Minutes with 99.9% Thorough Distribution of Minor Additives.

Now, for the first time, a batch mixer with exclusive "Triple Action" mixing. The blending, folding and mixing action created by this unique triple ribbon and spiral assembly exposes each particle in the mixture to over 10,000 separate mixing actions per minute. The center spiral breaks and tumbles the core of the mix and moves the material to the outer 2 ribbons which convey the ingredients in opposite directions, subjecting each particle to thousands of mixing actions per minute. This produces a well balanced, uniformly mixed product of the highest efficiency known.

**EXCLUSIVE FEATURE** — Nylon seals between the tub and shaft, with outboard bearings. This permits cleaning in a matter of seconds . . . is sanitary, long wearing and dustproof. There is no hold up of product from one batch to the next.

The versatile design of the Triple Action Mixer permits feeding from any location at the top with single or multiple discharges to suit individual requirements. Hinged, drop-door bottoms for easy cleanout. Constructed of steel, stainless steel or commercial alloys.

Strong-Scott maintains a complete Customer Service Laboratory with a full line of standard equipment for your convenience, with no obligation to you. Consult Strong-Scott for additional details.



PORTA-BLEND-A portable dry mix and liquid blender capable of quality results at high capacity.



TWIN ROTOR MIXERS—Accurate blending of liquids and dry mix at high or slow speed.



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For complete information on the equipment shown above, write to The Strong-Scott Mfg. Co.

Mfg. Co.

Equipment Designed for Better Processing 451 TAFT STREET, MINNEAPOUS 13, MINNESOTA

vevors.

Aside from transfer lines and compartmentized bin, essential parts (see sketch) include a blower, split-tube distributor, rotary air-lock feeder, cyclone separator and two screw con-

In the self-loading cycle, suction picks up solids from plant storage and deposits them in the cyclone separator, which discharges into the rotary air-lock feeder. Solids-free air leaves the top of the cyclone, passes through the return line into the blower.

Blower discharge picks up solids from the feeder, flows through a short flexible hose (connected only during loading) and enters the split-tube distributor which runs across the top of the truck bin. Air leaves the bin through filter hatches on top.

For unloading, the screw conveyors drop solids from the bin into the feeder. Pressurized air from the blower removes solids from the feeder and blows them directly into the receiving bin.

How Many Models—Sprout Waldron's bulk trucks are available in chassis sizes ranging from 12 to 36 ft. Normally, they are built to unload at rates between 18 and 24 ton/hr.; load at 8 to 10 ton/hr.

For existing standard bulk carriers, Sprout Waldron's Muncy, Pa., shops are set up to provide conversion service. Companies desiring to do their own conversions can obtain do-it-yourself kits that will change standard trucks to work-horses able to handle bulk shipments as well as bags and containers.—Sprout, Waldron & Co., Inc., Muncy, Pa. 94A

#### Radiant Heaters

### For applications requiring controlled economical heat.

A new line of tubular infrared radiant heaters, varying in size from individual 500-w. elements up to 36-kw. panels, is now available for use with ambient temperatures as high as 1,000 F.

Called Vicoray, the line comes completely wired and ready for erection and connection to Equipment Developments\_

Page number is also Reader Service Code number

Bulk truck loads and unloads itself with air94A
Radiant heaters provide controlled economical heat96A
Pyroceram tubing exhibits highly desirable properties961
Immersible motor eliminates long shafts and bearings960
Hazardous materials lab studies basic CPI problems98A
Spray head cleans compartmentized tank trucks98I
Humidity regulator supplements sensitivity of humidifiers . 980
Conveyor moves solids on a bed of air98I
Pipe insulation features fast application device100A
Valve packing needs no lubrication at high temperatures. 100H
Stainless-clad pipe offers economic protection1000
Oilless bearings withstand all abuse100L
Filter-bag zipper simplifies filter bag application100E

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either 120- or 240-v. service. Physical length ranges from 11 to 48 in.

Standard wave length is suitable for most applications; the producer also makes the units in modified wave lengths to meet special requirements. All units are guaranteed against burnout for 1 yr.—Douglas C. Whitaker Co., Inc., 141 East Glenside Ave., Glenside, Pa.

#### Pyroceram Tubing

Available commercially in \(\frac{1}{2}\)- to \(\frac{3}{2}\)-in, dia.

Early in 1958, Pyroceram brand tubing will become commercially available in quantity in diameters from ½- to ¾-in.

In heat exchangers, Pyroceram tubing will permit higher rates of heat flow per unit area, allow higher operating pressures and lessen considerably any chance of damage to the unit by abrasive particles.

Tubing is pure white and opaque with thermal shock resistance equivalent to that of fused silica. Coefficient of expansion for this material is 5 to 11 x 10<sup>-7</sup> cm./cm./deg. C. as compared to 32 × 10<sup>-7</sup> for borosilicate glass. Flexual strength of abraded Pyroceram Code 9608 tubing is 17,000-23,000 psi.—Corning Glass Works, Corning, N. Y.



#### Immersible Motor

For close-coupled submerged operation.

A new immersible motor can be close-coupled to agitators or pumps for submerged service in sewage sumps, chemicals, water and abrasive industrial oils.

In pump applications, this flange-mounted motor eliminates many connecting components such as intermediate bearings, couplings, shafting, and special bases since the motor shaft is attached directly to the impeller. Motor and pump can be raised and lowered into position together by means of the motor's lifting lugs.

Motor is available in ratings from \(^2\) to 40 hp., both single and polyphase.—Louis Allis Co., Dept. P, 427 East Stewart St., Milwaukee, Wis. 96C



From 2½-gallon pails to 55-gallon drums — including stainless — U.S. Steel offers the widest industrial container selection of all. Chances are there's a container here that's best for your needs. Your U.S. Steel representative will be glad to help you select the right one.

#### Profit from all 5 of these U.S. Steel extras, too:

- Eye-catching containers your containers not only ship your product, but advertise
  it, too when color-decorated by U. S. Steel.
- Best rust protection—there's more zinc phosphate on every USS rust-inhibited container.
- Prompt container delivery a 7-point factory system gives you next-door service anywhere — any time.
- Personalized container service your U.S. Steel salesman makes it his business to understand yours — to help you get the right containers for your needs.
- Longer container life extra zinc phosphate gives your containers a safer, longer lifetime.

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USS STEEL DRUMS



UNITED STATES STEEL



### Lab Probes Mixing Problems of Hazardous Material

Now in operation, Mixco's new Hazardous Materials Laboratory is designed to help the CPI solve basic mixing, blending and separating problems with Class I, Group D materials. Facilities will also supply answers to specific customer questions on suspension of solids, leaching

and solvent extraction, as well as "blue-sky" research. Featured lab equipment includes a Mixco multistage contactor (right, rear) which can be converted from 8 to 32 stages as needed. Six 100-gal. tanks hold feed, products.—Mixing Equipment Co., Rochester, N. Y. 98A

### Spray Head

Rotates to clean tanktruck compartments.

Smaller than a baseball, and weighing only 7 lb., the Spray-O-Mat drops through the smallest tanker opening to throw a spray of cleaning solution against all surfaces.

The main elements of the stainless steel unit are a trislotted rotary head, a selfcleaning ball race, and two nozzles, one for imparting motion and the other for spraying. Solution jetting from the offset nozzle spins the head around the race, scattering a three-directional liquid spray from the wide-angle nozzle and slots.

Oakite Products, Inc., which engineered the Spray-O-Mat, rents it to its customers on a nominal-fee basis. Aside from hose, pipes and valves, and a 100-gal. solution tank, Oakite recommends a pump to deliver 40 gpm. at a head pressure of 60 psi.—Oakite Products, Inc., 19 Rector St., New York 6, N. Y.

### **Humidity Regulator**

Controls air stream to  $\pm$  0.5% R. H.

Couple this automatic regulator to your present moisture-adjusting equipment and you will be able to maintain the relative humidity of the outlet air stream to  $\pm 0.5\%$  R. H. Used as an accessory with dehumidifiers, humidifiers, and air conditioners, the Humitrol overcomes humidity fluctuations caused by variable

machine performance and changing inlet-air conditions.

The type and size of Humitrol required for a particular job depends on the desired outlet relative humidity range, inlet-air temperature range, and airflow rate. Once installed, the Humitrol requires very little attention and maintenance.—Universal Dynamics Corp., 1441 Nineteenth St., North, Arlington, Va. 98C

#### Conveyor

Fluidization eliminates moving parts.

Fluidization techniques, employed in Fuller Co.'s new Airslide horizontal conveyor, are the key to non-mechanical bulk transport of fine, dry materials.

Conveyor consists of a series of horizontal floor courses connected by elevating passageways. A porous fabric, rigidly mounted in the enclosed housing, divides each floor course into upper and lower channels.

Low-pressure air, introduced into lower channel, permeates the fabric to fluidize bulk material in upper channel. Fluidized material flows by gravity down the slight incline of each floor course to the elevating passageway. There, greater airflow lifts the material to the upper end of the next floor course.

The sectional construction, which permits passage around or over existing equipment, facilitates installation without plant redesign.

Airslide will convey a diversity of fine materials such as fly ash, gypsum, iron ores, talc, resins and cement.—Fuller Co., Catasauqua, Pa. 98D

#### For More Information . . .

about any item in this department, circle its code number on the

#### **Reader Service**

postcard inside the



A REPORT TO OUR CUSTOMERS

### **Roots-Connersville**

# Expands Production Facilities

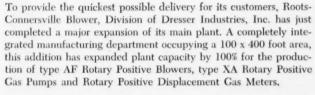
### To Serve You Better



Rotary Positive Displacement Gas Meters



Type AF Blowers'



The new facility is equipped with the most modern, automatic metalworking machinery to provide the utmost precision in machining and assembly operations. Representing a large investment, this equipment is your continuing assurance of high quality in Roots-Connersville products.

As rapidly as possible, a stocking program will be put into effect for all products manufactured in the new department. This program will serve to speed delivery and improve service for all customers.



**ROOTS-CONNERSVILLE BLOWER** 

A DIVISION OF DRESSER INDUSTRIES, INC.

258 Illinois Avenue, Connersville, Indiana. In Canada-629 Adelaide St., W., Toronto, Ont.





#### Pipe Insulation

Has built-in tie wires to speed installation.

New, speed-fastening, hightemperature #101 pipe insulation is designed specifically for runs of pipe that are to be weatherproofed with sheet metal or roofing felt. It is well suited for covering nested pipes and steam-traced lines since it can be manufactured to fit exactly without waste.

Exterior surface of the mineral wool is faced with 16-gage wire mesh which is held in place by tie wires running through the wool to the expanded metallath backing. You fasten insulation on pipe merely by hooking seven wires, which extend from one end of the outer mesh, under the opposite stay wire and bending them over and back.

Insulation is available in 2-ft. sections and 1½- to 4-in. thicknesses for pipe sizes from 4 to

30 in.—Baldwin-Hill Co., 500 Breunig Ave., Trenton, N. J. 100A

#### Valve Packing

Molded packing displays unique characteristics.

A new die-formed valve packing, recently introduced by Garlock, shows extreme versatility in medium temperature service.

Made from braided asbestos yarns that are strengthened with copper wire and impregnated with Teflon suspensoid, the valve rings feature a high degree of chemical inertness. The Teflon additive also acts as a lubricant, thereby eliminating the need for graphite or liquid

lubricants. Mechanical toughness and serviceability at temperatures up to 500 F. round out the list of desirable properties.—The Garlock Packing Co., 412 Main St., Palmyra, N. Y.

#### Stainless-Clad Pipe

Now available down to 4-in. diameter.

New advances in welding techniques have enabled Lukens Steel Co. to bring forth stainless-clad pipe in diameters as small as 4 in.

Inside surface of the pipe is a layer of solid stainless steel, completely and permanently bonded to a heavier outer layer of carbon steel. Like Lukens stainless-clad plate, the new pipe will give all the benefits of solid stainless, but at lower cost.

Lukens' new development was helped into fulfillment by Youngstown Welding & Engineering Co. Together they achieved economical techniques for fabricating and joining the pipe while still preserving the integrity of the vital inner layer of stainless steel.—

Lukens Steel Co., Coatesville, Pa. 100C

#### **Equipment Cost Indexes**

Dec.

	142/	193/
Industry		
Avg. of all	225.0	229 2
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221.6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber Ind	224.8	229.1
Process ind. avg	223.7	227.0
Related Industries		
Elec. power equip	229.8	232.9
Mining, milling	228.0	231.8
Refrigerating	254.0	258.9
Steam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different Industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; March 1957, pp. 266–7 for annual averages since 1913.

#### Oilless Bearings

Outlive babbit by twenty to thirty times.

Claimed to be indestructible, the new Fluoroglas bearing for pumps and motors is ideal for processes demanding complete freedom from contamination. Requiring no lubrication, they should be most useful in pharmaceutical, food and textile process equipment.

Molded or extruded from a Teflon-based mixture, these light-weight bearings will efficiently withstand any corrosive or chemical atmosphere within a temperature range from -200 to +500 F.

Where maintenance is a problem, low-friction Fluoroglas bearings will eliminate breakdowns resulting from rusting, pitting or wipe-out.—Fluorulon Laboratories, Inc., Caldwell, N. J. 100D



#### Filter-Bag Zipper

Plastic fastener facilitates installation and removal.

Custom-tailored cloth filter bags, equipped with corrosionresistant polyethylene zippers, should soon improve many operations employing leaf filters, dust bags and air ducts.

Available with any kind of fabric, the jam-proof fasteners ride in smooth grooves, with no teeth to snag or collect material being filtered. Zippers are sewn to the cloth with a specially-developed stitch that prevents leaking.

Units are available with either lip-type closure, which withstands 80 lb. pull, or conventional slide fastener.—Filtration Fabrics Div., Filtration Engineers, 155 Oraton St., Newark, N. J.

# the <u>OTHER</u> Advantages of a Kinetic Seal

The obvious reason for choosing a LaBour Type G, the packingless self-priming centrifugal pump, is that it never has to be repacked. But there are other advantages resulting from the unique kinetic seal which should not be overlooked.

LaBour Type G is sealed by the action of a freely turning part, not by the part itself. Nothing in the kinetic seal rubs against anything else at any time—in fact, the clearances aren't even close. Because there is no packing there is no possibility of contaminating the product being pumped.

Visible leakage from a stuffing box can be spotted and corrected when it occurs, but in many situations the invisible leakage of air or gas into the liquid can be a source of great trouble and expense. The LaBour kinetic seal cannot deteriorate through wear, and cannot leak in either direction.

If you haven't considered all the advantages of LaBour Type G with its kinetic seal, it will pay you to write us for the complete story.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

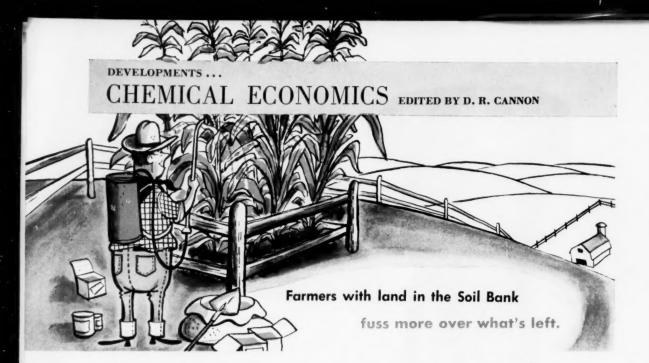
1-ABOUR

THE LaBOUR COMPANY, INC.

ELKHART, INDIANA, U.S.A.







### Pesticides Figure on Boost From Soil Bank

The Soil Bank pays farmers for not using Acre A for surplus crops. Farmers, being human, then try to get more out of Acre B. Pesticides help them do it.

Melvin Goldberg, Pesticide Advisory Service, New York, N. Y.\*

Pesticides, like all agricultural chemicals, are sensitive to shifts in Federal farm policy. Fate of the Soil Bank, for instance, will determine to a considerable extent what happens to pesticide sales in the next couple of years. If, as is likely, the Soil Bank continues in effect that long, pesticides will profit, because the farmer, as he restricts acreage in return for Soil Bank payments, attempts at the same time to maximize yields from his remaining land by using greater amounts of agricultural chemicals.

He may even plant non-surplus crops on Soil Bank land and thus use pesticides on this acreage.

Solid Future—As for the longrange view—say two decades ahead—pesticide industry hopes are high. For farm output in 1956-57 was approximately onethird greater than in 1940, with practically no increase in the number of acres planted. It is felt, though, that a supplydemand balance may be reached in the 1960s, that farm output required in 1975 will be one-third larger than that needed in 1952-53.

Obviously, all this means we must have greater utilization of land under cultivation, greater insurance that farm products will be brought to harvest.

Enter more agricultural chemicals

► Last Season—So much for the long view. What happened in 1956-57?

Agricultural pesticides suffered from the same malady as the rest of the chemical industry: Narrowing profit margins offset any increase in sales. General tendency at the beginning of the season was to increase prices to take care of increased costs, including freight increases. But as the season progressed competition pushed prices—and profit margins—down.

Actually, sales in 1956-57 weren't much better than they were the previous season. Consumption was up a bit, but tended only to take care of higher-than-normal carryover supplies from the 1955-56 crop year.

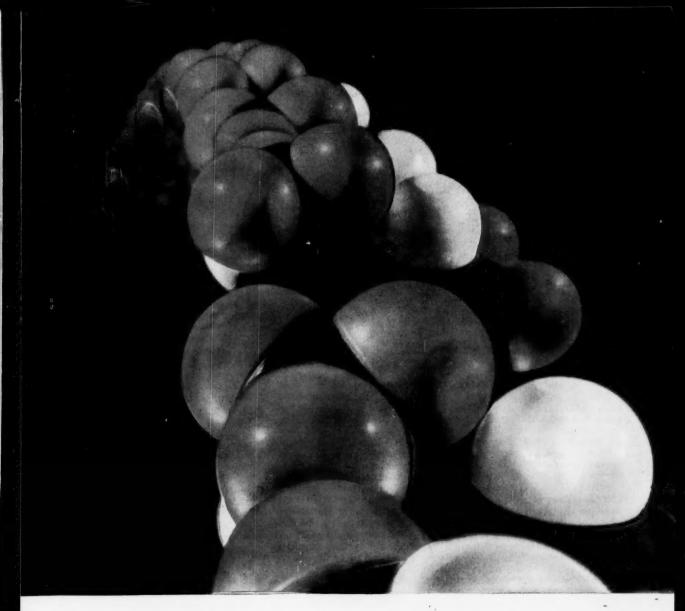
However, the extra supplies were worked off without weakening the market; inventory going into 1957-58 is pretty normal.

Marketing practices are noticeably better throughout the pesticides industry. Consignment selling is on the decline. Increased concern for profits is reflected in attempts by most manufacturers to widen margins on prices.

Since weather and crop conditions vary between sections of the country, we'll summarize the situation in each of the major areas during the past season.

► South and Southeast — Overall 1956-57 pesticide sales matched or were slightly greater than in 1955-56. Weather played an important part in the heavy cotton areas. In some parts of Texas rainfall increased pesticides sales through continual washoff; in other parts, rain was so heavy it ruined crops and reduced or voided pesticide sales.

<sup>\*</sup>Meet your author on p. 175.



### VINYL MONOMERS... endless possibilities, thanks to polymer chemistry



Vinyl acetate . . . vinyl propionate . . . methyl isopropenyl ketone . . . and now

acrylic acid esters... these Celanese monomers are starting points for practically endless product improvements. They have already enabled production of better binders for non-woven fabrics and for water and grease-resistant coatings. They have improved plastics... they have improved the properties of

emulsions for latex paints, leather, paper and textiles... they have enhanced properties of synthetic fibers and rubbers.

These are but a few of the improvements engendered by the Celanese series of monomers. And Celanese research, development and production know-how promise more and better basic materials for polymer chemistry. The new acrylic acid esters, for example. The unit for their production is nearing completion

and soon will be "on stream," supplying acrylates in commercial volume.

Constant research for more productive basic organic chemicals...availability of a vast supply of raw materials to keep production in continuous volume...these are the factors upon which Celanese bases its service to industry. Celanese Corporation of America, Chemical Division, Dept. 553-B, 180 Madison Avenue, New York 16, N.Y.

### Basic reasons.....

Acids Function
Alcohols Gasoline
Aldehydes Glycols
Anhydrides Ketones
Esters Oxides

Functional Fluids Gasoline Additives Glycols Ketones Oxides] Polyols Plasticizers Salts Solvents Vinyl Monomers



### ... for improved products

Agricultural Automotive Aviation Building Electrical Paper
Pharmaceutical
Plastics
Surface Coatings
Textiles

### Pesticide Use: Some Slips in 1957

(Thousands of pounds in domestic use)

Crop Year (OctSept.)					
Product	1954	1955	1956	1957*	
BHC and Lindane	8,500 27,251 45,117 2,906	7,800 28,000 61,800 2,500	9,450 32,000 75,000 4,400	7,900 31,000 70,000 3,500	
chemicals** Copper sulfate Calcium arsenate Lead arsenate Pyrethrum Rotenone	35,500 60,000	57,000	61,570 50,000	63,000 40,000 22,000 12,000 7,000 5,950	

Source: U.S. Dept. of Agriculture; National Agricultural Chemicals Assn. \*Author's estimates. \*\*Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Toxaphene.

Yet in still other Southwest areas, the weather was dry and hot, bringing control programs to a halt and reducing pesticide consumption correspondingly.

Because of these weather conditions, sales of pesticides in many areas of the South ran from one to one-and-a-half months behind normal schedules. In the delta area, pesticide sales for cotton insect control ran 35% behind those of 1956, up to June 1. Although there was a slight pickup in July and August, this season was disappointing to the delta area.

There was further notice of the hard-to-kill insect in the South. One result: A continuing shift by farmers from chlorinated hydrocarbon insecticides to the thiophosphates, like Parathion and Malathion—a trend started last year. Louisiana even prohibited, at the beginning of the season, use of chlorinated hydrocarbons for control of cotton pests, because of alleged ineffectiveness.

Actually the so-called resistance problem varies with different locations. For example, in Alabama resistance increased; in Mississippi, there was every indication that resistance, if anything, declined.

► Counterattack — Many basic producers of technical chemicals have conducted experiments to show that this particular problem of insect resistance has been over-emphasized. For two years, starting in 1955, Hercules Powder conducted extensive field tests to determine how serious was the resistance to chlorinated hyrocarbons. The results indicate that these pesticide materials can control cotton insects—if the timing and application are correct.

The Miller Amendment to the Federal Food, Drug and Cosmetic Act, which places toxic pesticidal chemicals under control as to use and allowable residues, caused further variations in pesticide marketing in the South. In some areas like Florida, where fruits and vegetables are the most important crops, the bill has done little except make growers more careful in their use of pesticides.

However, it has caused a shift in demand for pesticides in the cotton belt. There, demand has increased for materials with low toxicity to mammals—materials, incidentally, which are generally less effective and less economical than those with no established tolerances.

► Midwest Research—The Midwest was prominent in three new fields of research:

Systemics—A new material, Thimet, shows some promise of controlling Hessian fly on wheat. There has been no chemical control for this pest to date; it has been avoided only by planting wheat at the proper time.

Antibiotics-Used to control

wildfire on Kentucky tobacco and fireblight in commercial orchards.

Parasites—In the field of biological control, insect parasites like the Lydella took care of about 30% of the hibernating corn borers in Ohio last year. And the USDA Corn Borer Research Laboratory in Iowa is working with a fungus applied with granular clay as a carrier. Results to date on first-brood borers are excellent.

▶ Dry East—Drought conditions greatly affected pesticide sales in the East. A reduction in plant diseases resulted from the dry weather, adversely affecting fungicide markets. There was further decrease in use of copper fungicides, as growers, seeking greater effectiveness, safety and price stability, continue their swing to organic products.

Industry spokesmen point out, though, that losses in pesticide sales in the East were balanced (at least for the distributing companies) by a more stabilized market and improved profits.

► Exports Even — Export demand has been normal, with government purchases of DDT and Dieldrin on the upswing for malaria control. South and Central American demand for BHC and other cotton and coffee insecticides has fallen off since imports from Western European countries have substantially cut into the amount of materials normally imported from the U.S. Strengthened Research - The National Agricultural Chemicals Assn. estimates industrial spending to find and develop newer pesticides and better application methods has nearly doubled since 1950 (\$15 million/yr. vs. \$8 million/yr.). Add \$5 million from Federal agencies, including the Dept. of Agriculture, and you have \$20 million/yr. going into pesticidal research.

▶ Miller Bill Costs—The Miller Bill is creating more of a problem to the industry than expected. When the amendment was passed, basic manufacturers, distributors and consumers alike felt they could live with the new regulation. They thought that, while it would lead to increased costs, the industry would benefit in the long run.

Now there is strong criticism



# POSITIVE, CONTROLLED LUBRICATION SEALS AND PROTECTS QCf. PLUG VALVES

**acf** Lubricated Plug Valves are tight against head leaks and are protected against wear and corrosion by the full distribution of the lubricant over the internal working surfaces of the plug and body.

Line fluid is protected from lubricant contamination by a unique ocr feature that forces all excess application of lubricant to escape around the neck of the plug to atmosphere.

Other good reasons for specifying acf Lubricated Plug Valves are:

Full Pipe Area Ports, Non-Wedging Cylindrical Plug Provides Easy Operation, Maximum Flow Efficiency, Patented Teflon\* Head Gasket.

Specify QCf Plug Valves and be sure of efficient, trouble-free service.

acr Valves are available through your industrial jobber or supply store.

W-K-M

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Check your ACF Representative for recommendations on the ACF Lubricant best suited to the lading carried by your valves or write for Catalog 400 on ACF Lubricated Plug Valves and Catalog 800, Lubrication Manual for ACF Lubricated Plug Valves. Address Dept. P-210

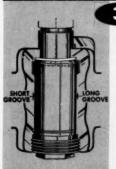
MANUFACTURERS OF W. K.M. GATE VALVES OF GCC LUBRICATED PLUG VALVES KEY-KAST ALLOY STEEL PIPING FITTINGS



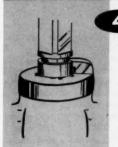
The lubricant stick (or bulk lubricant used with standard gun and accessory fitting) is forced into the valve through the plug stem. A ball check prevents the line pressure from escaping.



The lubricant is forced outward from the stem lubricant chamber into four equallyspaced lubricant pockets in the body which line up with the four lubricating grooves on the surfaces of the plug.



There are two short lubricating grooves on the plug and two long ones. The short grooves are the ones which pass over the ports when opening or closing the valves. These grooves are isolated from the lubricating system when the valve is being operated so there is no possibility of forcing the lubricant into the line. In full open or full closed position all four grooves receive a full charge of lubricant which spreads fully over the surface of the plug and body when the valve is operated.



When the valve is fully lubricated any excess lubricant is forced out of the body around the neck of the plug—it never enters the line. In this way there is positive visible indication that the valve has been fully lubricated and over-lubrication with the attendant contamination of the line fluid is impossible.



Self-lubricating Teflon head gasket seals tight. The lubricant grooves do not extend beneath the plug, leaving the bottom space free for line pressure to force the plug tighter against the head seat.



#### Systemics

Moving all through the plant, these chemicals get the bug no matter where he dines.



#### **Antibiotics**

In the face of a stiff price tab, wonder drugs start paying off on the farm.



#### **Parasites**

Hoped-for answer to the pest that hibernates: Attack from his own kind.

of the Miller Bill from basic producers. They say developmental costs have been substantially increased at the same time that profit margins are shrinking. Furthermore, the increased paper work, time lag and burdensome expense has affected the introduction of newer products. One manufacturer estimates that introduction costs for the newer chemicals are almost 80% over what had previously been deemed necessary.

Spray by Air-In October a USDA report predicted that application of agricultural chemicals by air-so-called "agricultural aviation"-will quite likely show spectacular progress in future years. This is an exciting prophecy inasmuch as the trend to aerial dispersion of chemicals began at the end of World War II; already one-fifth of the nation's 410 million cultivated acres is treated by aircraft.

Special planes, engineered specifically for proper dispersal of both liquid and dry chemicals, will be developed to replace the war surplus aircraft that have carried so much of the load thus far. Aircraft experts point out that future planes will be designed for slower flight, shorter takeoffs and landings, improved pilot visibility and maximum safety. Some are already in the works.

In the 1956-57 agricultural

year, public and private agencies aerially treated more than 100 million acres of forests and farms. The USDA, in cooperation with several northeastern states, sprayed 3 million acresin New York, New Jersey and Pennsylvania - with DDT to combat the gypsy moth.

Spruce budworm control again was important in Montana, Idaho and neighboring western states. Grasshopper control, financed by federal agencies and cooperative states, accounted for an additional 10 million acres. In 1958 government programs for control of the gypsy moth in the East will again cover about 3 million acres.

► New Entries — The pesticide industry last year featured several new compounds. A whole raft of organophosphates was introduced. Antibiotics began to find their place in the agricultural chemical business as plant disease agents.

In the case of tomato, green pepper, beans and similar plants, antibiotic treatment is carried out during the seedling stages. Thus the antibiotic is removed or destroyed before the edible part of the plant is formed.

On fruit trees, also, spraying or dusting is done before the fruit develops-before and immediately after blossoming-so as not to come under Miller Act restrictions.

#### **Chemical Consumption**



#### Consumption by Industries

	Sept. (Final)	Oct. (Est.)
Coal products	11.1	11.2
Explosives	12.4	11.7
Fertilizer	63.0	72.2
Glass	26.7	28.7
Iron & steel	16.5	16.9
Leather	4.1	4.0
Paint & varnish	31.9	32.2
Petroleum refining	31.1	31.1
Plastics	25.6	27.7
Pulp & paper	35.4	39.4
Rayon	26.7	28.6
Rubber	6.7	7.6
Textiles	9 2	10.6
Total	300	322



#### OTM'S COMPLETE INSPECTION

. . . is thorough and painstaking. Magnaflux tests (as above) are made both before and after machining to eliminate any possibility of surface flaws. Numerous micrometer checks assure tolerances closer than specified by ASA or API. Radar-type Reflectoscope inspection (left) detects any interior flaws

Reflectoscope detects pin point flaws to 40 feet.

For the name of your nearest OTM distributor Call UN 2-6643

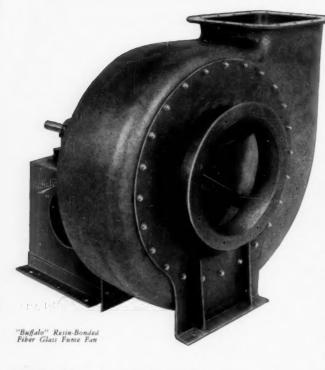
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BUFFALO" UNITS

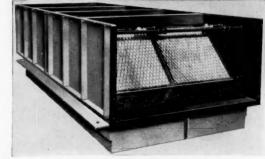
CORROSION-CONTROL PROBLEMS?

The broad line of "Buffalo" equipment for corrosion control, plus our 80 years of engineering experience in this field, insures you of the most effective solution of your corrosive fume problems.

Whatever your specific needs, you will find the right "Buffalo" product with the right protective coating and/or corrosion-resistant parts to fill that need.

Contact your nearby "Buffalo" Engineering Representative, or write us outlining your problem. We will be glad to provide you with a prompt, practical, economical





Top
"Buffalo" Cast Iron Exhauster

"Buffalo" Gas Absorber

"Buffalo" Type "FG" Fume Fans provide superior chemical resistance to a wide variety of corrosives, including acids, salts, gases, organic materials. Temperature applications range up to 225°F.

The fan housing is formed of resin-bonded fiber glass. All exposed areas of the carefully-balanced steel rotor are encased in thick fiber glass. The "FG" is available in standard capacities up to 34,000 cfm at pressures to 10" static.

For full details, including chemical resistance table, write for Bulletin

"Buffalo" Cast Iron Exhausters, widely-used throughout the chemical process industries, are engineered to operate under the most extreme corrosive conditions.

Husky cast iron housings, plus cast inlet cones with integral inlet vanes, guide air smoothly into the wheels. The result is the lowturbulence air flow inherent in this high-efficiency design. Non-overloading is insured, regardless of system pressure.

Three arrangements are available: direct motor drive, separate belt drive or a package unit with adjustable pitch V-belt drive and motor mounted on adjustable base rails.

For full information on "Buffalo" Cast Iron Exhausters, contact your nearest "Buffalo" Representative or write us direct.

"Buffalo" Gas Absorbers are designed for highly efficient removal and/or recovery of soluble gases, vapors and mists from exhaust systems before discharge to the atmosphere. Absorption is accomplished when the contaminant is completely in solution. This is accomplished by means of an absorbent liquid sprayed on a series of fiber cells.

Field performance tests prove that efficiency of "Buffalo" Gas Absorbers ranges up to 99.8%. Applications fall into two categories: removal of low concentrations from stack gas effluents for prevention of atmospheric pollution, and the absorption of process or off-gases containing sufficient material to make reutilization economically feasible.

Bulletins AP-225 and AP-2500 will guide you to the proper "Buffalo" Gas Absorber to solve your contamination problem. Write for it today.

EVERY "BUFFALO" PRODUCT FEATURES THE "Q" FACTOR — the built-in Quality which provides trouble-free satisfaction and long life.



#### BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING

AIR CLEANING . FORCED DRAFT . COOLING . HEATING

AIR TEMPERING

INDUCED DRAFT PRESSURE BLOWING EXHAUSTING

# World's First Nuclear-Powered Surface Ship will have MIDWEST Welding Elbows



U. S. Navy's guided missile, nuclear-powered cruiser "Long Beach"

#### Special Fittings are "ROUTINE" for Midwest



Special Elbows (dimensions, tangents, wall thicknesses and materials) are easily provided by the exclusive and flexible Midwest method. Elbows are available in any material that can be secured as plate, which also means better delivery. Closer tolerances are inherent in the Midwest process. Quality control always exceeds Code requirements.

Shown here are three of the special stainless steel and stainless-clad elbows made by Midwest for the "U.S.S. Long Beach". All reactor coolant piping must meet extremely rigid specifications because of the difficult service. Special quality controls, such as ultrasonic testing, intergranular corrosion tests, dye checking, radiography, and ring flattening tests were used one or more times at various stages of manufacture from the raw material to the finished fittings. Special quality standards for soundness of metal, "water clear" welds, dimensional accuracy, and surface finish were satisfied.

The U. S. Navy's first nuclear-powered surface ship, the "Long Beach", will introduce a radically new concept in defense capabilities. She will operate offensively and independently of other forces under conditions of both nuclear and non-nuclear warfare against airborne, surface or under-sea opposition. In addition to equipment and weapons for detecting and destroying enemy submarines, she will carry the Navy's modern guided missiles.

The piping for the atomic reactors being designed and developed by the Westinghouse Electric Corporation will use a large number of special heavy wall stainless steel Midwest Welding Elbows. This is not the first atomic project for which Midwest Welding Fittings have been used. In fact, when the nuclear propulsion program first began, Midwest furnished special welding fittings for the "Nautilus" prototype installation at Arco, Idaho.

Whether or not you are concerned with nuclear power, Midwest Welding Fittings (both stock and specials) will do a better job for you. Ask your Midwest distributor or write us for Catalog 54, which tells you why.

#### MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Missouri (P.O. Box 433)

Plants: St. Louis, Clifton, N. J. and Los Angeles

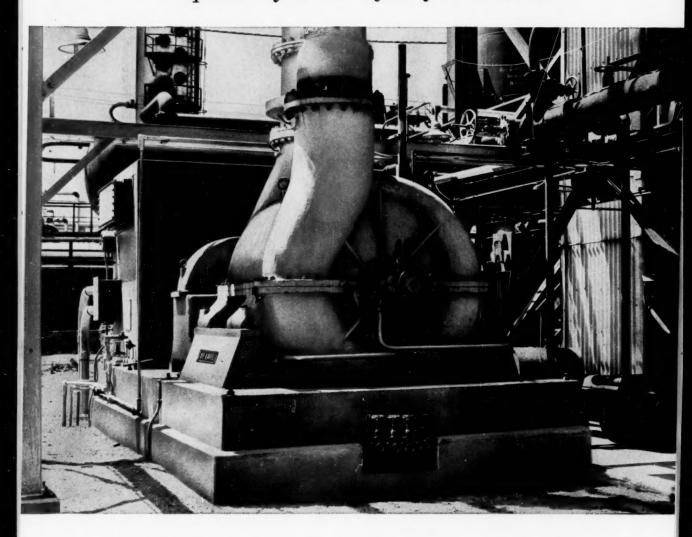
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## Another **DE LAVAL** combustion air compressor dependably serves refinery cat cracker



On stream at the Coffeyville, Kansas plant of the Cooperative Refinery Association, this De Laval Centrifugal Compressor delivers 24,100 cfm of air. Inlet pressure is 14.0 psia, discharge pressure 38.9 psia. Compressor output is controlled with adjustable inlet guide vanes.

This De Laval main air compressor is driven by a 2500 hp, 1800 rpm motor. Shaft speed is increased to 4800 rpm through a De Laval double helical speed increasing gear.

Cooperative Refinery Association is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.





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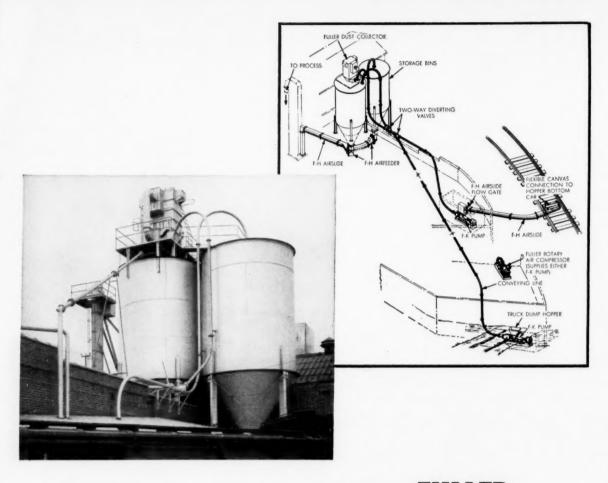
In industries using chemical processes and techniques . . . their products range from explosives to cosmetics . . . the one unifying influence is the active presence of the chemical engineer and his technology. These industries buy big . . . a third of all capital goods, \$46 billion in raw materials and fuels . . . and it's the chemical engineer who rec-



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Published every other monday for Chemical Engineers in all functions



## Unloading and Conveying System By **FULLER---**Pays Off In Lower Operating Costs for Certain-teed

A few years ago, Certain-teed Products Corporation decided to find, if possible, more economical methods of operation in its York, Pa. plant. One problem given serious consideration was the handling of incoming limestone and slate filler dust received in bags, requiring costly, manual labor, resulting in breakage of bags with consequent loss of material and a dusty condition in the plant.

Together, Certain-teed and Fuller engineers made studies of their layout and came up with a solution—a combination of the Fuller-Kinyon Conveying System and F-H Airslides®.

Two Fuller-Kinyon Pumps are used. One conveys limestone dust from hopper-bottom cars, utilizing the Airslide to convey from cars to the pump located in a pit in the plant. This pump conveys to either one of the two storage bins . . . efficient, clean, rapid transfer from cars to storage. The other pump handles the slate dust, delivered in trucks, also conveying to storage. Withdrawal of either material from storage bins is accomplished with Airslides, which discharge to an elevator delivering to process.

Air for the pumps is supplied by a Fuller Rotary Single-stage Compressor, having a capacity of 482 c.f.m. at 20-lb. pressure. Low-pressure air, for the Airslides, is supplied by a small blower.

It is reported that the savings realized by the use of this Fuller system has paid for the installation in less than two years of operation.

Possibly your materials handling is antiquated and costly, which could be remedied by a comparatively small investment. Fuller's 30 years experience in pneumatic conveying of dry bulk materials can very well bring about substantial savings in your plant's operation. Why not write today for further information? No obligation at all.

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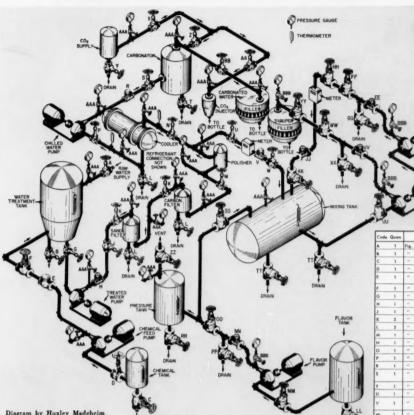
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How to plan piping connections for

#### A CARBONATED SOFT DRINK BOTTLING PLANT

Preparation and bottling of soft drinks, requires a supply of treated water for diluting concentrated flavors in the mixing tank, thus making the syrup which is fed into bottles or cans by the syruper. Another operation carbonates water and feeds it into the bottles as the second ingredient. This layout also may be used for a "pop" canning plant, by changing the connections out of the three fillers.

Consulting Engineer

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The water treatment system here is typical. Bottles (or cans) are first filled with syrup from the mixing tank, then filled with carbonated water and, just before closure, injected with carbon dioxide gas to eliminate air.

Water treatment lines are red brass or copper with bronze valves and bronzefitted pumps. The chemical line is controlled with all-iron valves to minimize effects of alkali corrosion. Stainless steel liquid sugar and flavor lines have stainless steel valves.

Either the Jenkins Fig. 1317-A Globe Valve or Fig. 1313 Twin Bolt Body Globe Valve (shown in the layout) is recommended. Jenkins Fig. 1317-A has the advantage of a multiple bolted body-bonnet joint which assures absolute tightness yet permits easy dismantling for cleaning or renewal of parts.

For details of valves to suit varying conditions see Jenkins Catalog. Consultation with accredited piping engineers and contractors is recommended when planning any piping system. Jenkins Bros., 100 Park Ave., New York 17. \*Or Fig. 1317-A, Multiple Boltod Bonnet Globe



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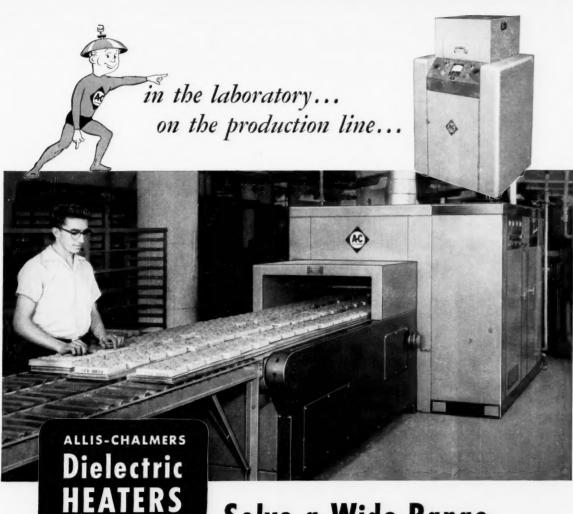
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### Small Change Nets Wax Process Dividends

First step to plant revamp and expansion: Esso engineers redesigned furnace at key process point, uncorked heat bottleneck.

IGHTENING the last bolts on a recent revamp and expansion at its Bayonne, N. J., wax plant, Esso Standard Oil Co.-now producing 20% of the world's wax at this site-quietly boasts the biggest such plant in the world: an efficient, highly tuned, 400-ton/day solvent-extraction setup.

Solvent-extraction route followed by Esso links four main process units-methyl ethyl ketone (MEK) solvent-extraction plant, a Hydrofiner catalytic hydrogenation plant, a vacuum pipe still and a bauxite

More important than present plant size, however, is the engineering that Esso brought to bear on a process weakness which had kept the wax plant from peak operation: inefficient solvent recovery in the oil-flash towers of the MEK plant. It's a prime example of how modest equipment changes can pay handsome dividends.

► Wanted: More Btu's—Esso engineers found that the root of the trouble lay in poor heating of the oil-solvent stream between lowand high-pressure sections of the flash tower. In the existing in-duced-draft furnace, flame impingement on furnace tubes and walls was sorely bottlenecking heat and wasting fuel.

So, according to Dick Preston, Division Head, Wax Manufacturing at Bayonne, when Esso began to plan boosted capacity, it first set about uncorking this Btu bot-

Engineers revamped the furnace by installing forced-draft burners and fans, and tacking on an automatic control system to monitor feed-fuel ratio. Redesign upped capacity of the solvent recovery furnace by 11% and boosted furnace efficiency throughout the entire firing range.

With other modernizing touches, such as a control system to automatically "hot wash" rotary filter cloths and depressurize scrapedsurface heat exchangers, Esso's expanded and updated wax plant is logging impressive records.

► Gas Oil Goes the Route—Waxy feed, usually a light gas-oil cut from Esso's nearby Bayway, N. J., refinery, is treated (at a temperature slightly above melting point of wax) with a methyl ethyl ketone-toluene solvent mixture and cooled in double-pipe (6-in. in 8-in.) exchangers and ammonia chillers to about 25-35 F. Wax crystallizes out in first-stage rotary vacuum filters and oil stays dissolved in solvent.

Toluene controls miscibility of feed stock and MEK. Without the toluene, Preston points out, feedstock composition would be too limited. Composition of the solvent mixture depends largely on the type of feed being dewaxed. More paraffinic stocks need less MEK than do naphthenic or asphaltic stocks.

► After Filter, Flash—After firststage filtering and washing and diluting with cold solvent, the wax-rich stream (still containing about 2% oil) is filtered in secondstage filters to less than 0.5% oil. Then it's fed to the two-stage wax flash tower. Here solvent is flashed off from the wax in low-pressure (atmospheric) and high-pressure (30 psig.) flash stages.

forced-draft furnace design cuts fuel consumption boosts solvent-recovery efficiency and throughput Result: world's largest and most modern wax plant

Unfold Flowsheet

Oil-rich filtrate from the firststage filters is routed countercurrent through double-pipe exchangers to cool incoming waxy feed, then, like the wax stream, goes to an oil flash tower where solvent is flashed in two stages (atmospheric and 30 psig.). Filtrate from second-stage filters acts as first-stage wash and dilution. Both wax and oil flash towers flash solvent to storage for re-use.

► Hydrogen Upgrades Wax—Oil and wax streams from the flash towers, at 400-450 F. are sent to steam-stripping columns where remaining solvent is stripped. Dewaxed oil is pumped back to the Bayway refinery. Wax, at about 350 F., is pumped to a furnace, heated to 400-600 F. and sent to

the Hydrofiner.

In the Hydrofiner, wax is hydrogenated over a fixed-bed catalyst (cobalt and molybdenum oxides or nickel-on-kieselguhr) at roughly 450 F. under pressure. Hydrofiner removes sulfur, stabilizes color and composition of the wax and upgrades the final product.

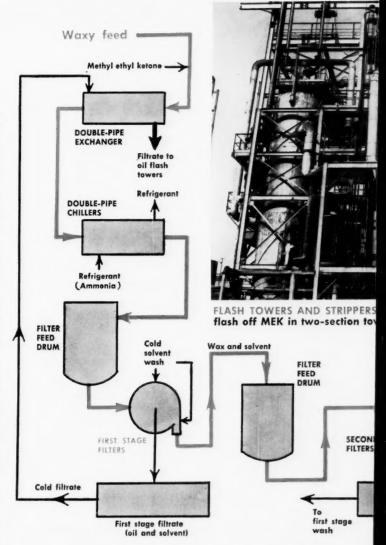
Catalyst may be regenerated in place with flue gas or air and steam.

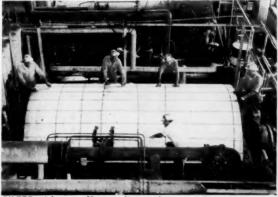
After Hydrofining, wax is steam stripped in a small (3-5 plates) column to remove H<sub>2</sub>S and hydrogen which, mixed with fresh make-up, is recycled to the reactor. Wax product is heated and pumped to the vacuum pipe still where it's split into three streams.

▶ Pipe Still and Porocel—Operating at about 700 F. and 10 mm. of mercury, the vacuum pipe still splits wax into different meltingpoint grades (overhead, bottoms and wax product). These are blended, if desired, and pumped to a bauxite-filled Porocel unit to filter out final impurities. Bauxite is regenerated in a roasting oven at 1.100 F.

The roasting oven, Preston adds, regenerates about 30 tons/day of bauxite clay.

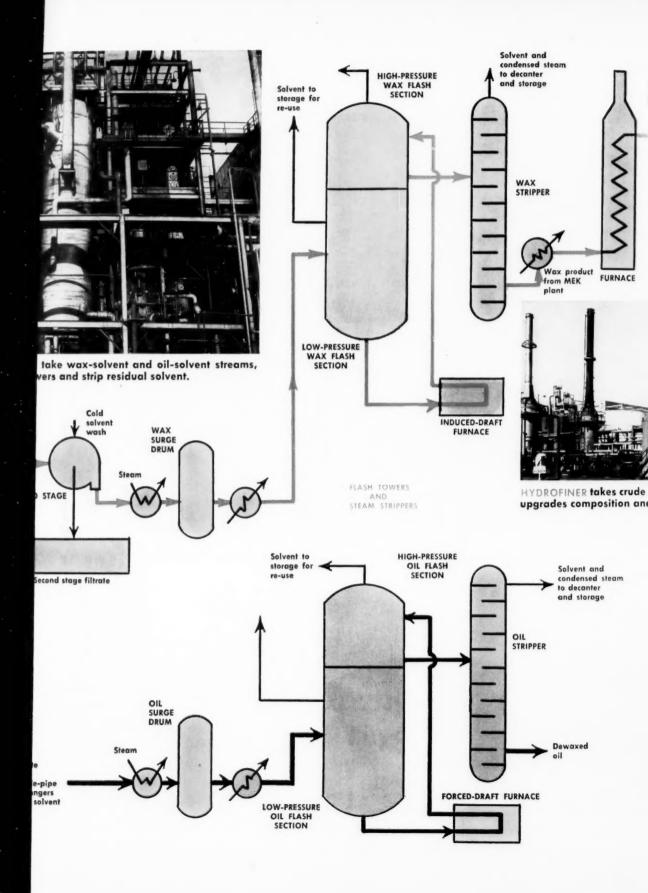
After this final filtering, wax is routed to insulated tank cars or winds through a huge refrigerating unit that chills and solidifies wax in cakes.

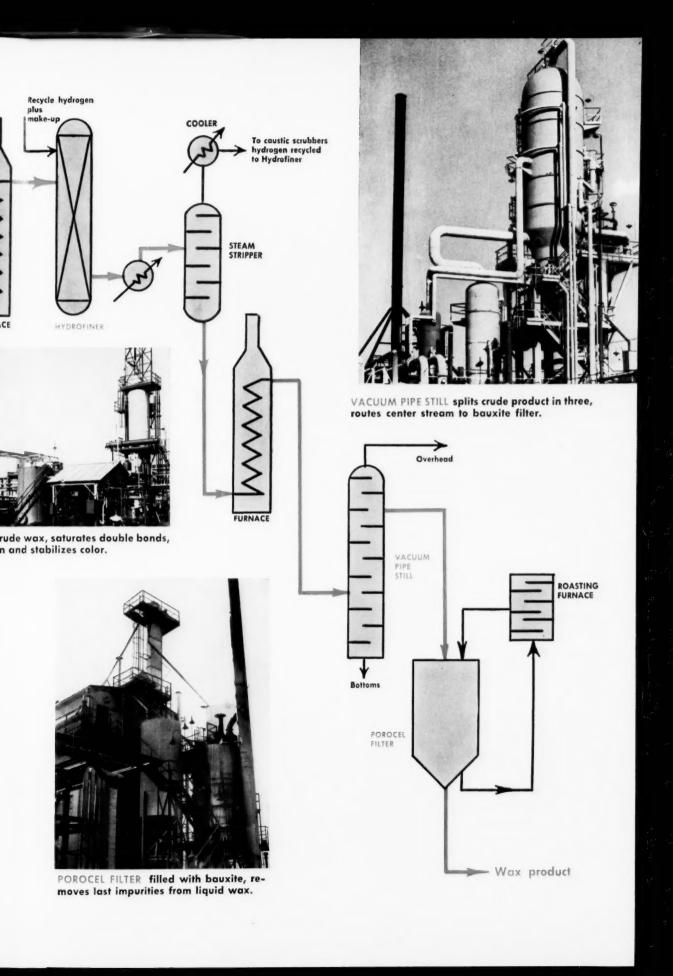




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For every process fluid, there's a better Crane valve



#### These valves on corrosive steam\* lasting 4 times longer

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The installation is on 150 psi, steam to a siphon tank of 66° Baumé sulphuric acid. The acid is mixed with steam to spray ink off screens in a wet end process.

On occasion the siphon line is left in the vat, causing condensation which forms a vacuum. This pulls acid back into the line and through the valve.

With brass valves in the line, the corro-

sion forced replacement every week. Another make special alloy valve was tried; it lasted 12 weeks. Better, but not good enough!

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\*This "Craneloy 20" valve is not ordinarily recommended for steam, but here the sulphuric acid mixture provides enough lubrication to retard galling.



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CHEMICAL ENGINEERING—February 10, 1958

## Two in One

### Raymond Flash Drying combines DRYING and **PULVERIZING**

in ONE integral **Unit of Equipment** 

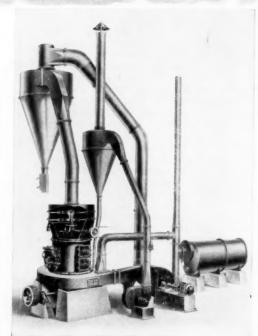
The urgent need for cost reduction makes Raymond Flash Drying equipment an important factor in many chemical processes. The Raymond system of removing moisture while grinding is the most direct method of producing finished materials in dry powdered form.

Flash drying may be applied to the Raymond Roller Mill, as shown, as well as the Imp Mill or Cage Mill, so that it has wide flexibility in application. It is used in handling fine chemicals, filter cake, clays and various non-metallic minerals.

The fine particles are dispersed in, and carried by, a high velocity heated air stream. As a result, drying is practically instantaneous with high thermal efficiency. The finished material is closely controlled in dryness, fineness and temperature, insuring a quality product.

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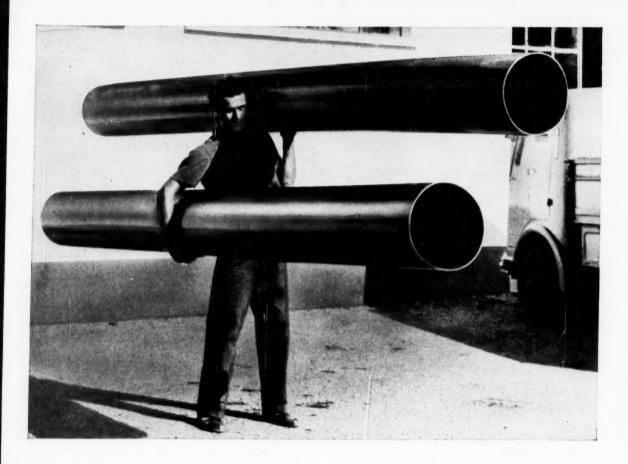
## Practice

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In your design work, have you noticed the real need for data on chlorine and HCl in a usable form? Try these pressure-enthalpy diagrams. They'll come in handy.	



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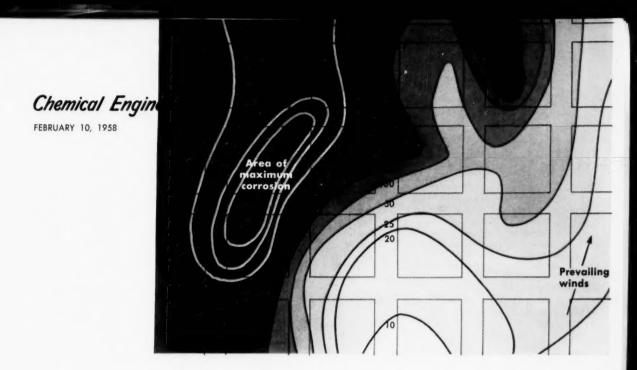
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## **Map Your Protective Coating Program**

Is atmospheric corrosion eating away at your profits? If so, it might pay you to read this factual account about Dow's prevention program.

ORROSION is like the weather—always with us and always a topic of conversation, but rarely does anyone do anything effective about either. Dow Chemical Co.'s Texas Division, having a lot of corrosion to live with, is doing something about it. The result, besides being money in Dow's pocket, promises to be a good thing for industry all over the country.

For Dow, the big pay-off has been in slashed maintenance painting costs—40% less than eight years ago.

In addition, they now have their corrosion control program on a scientific, quantitative basis that, in future years, will continue to pay off in:

1. Paint schedules that virtually remove all guesswork from decisions on the when, where, how-to and what-with of plant painting.

The material for this report was secured by Ronald E. Cannon when he was a field editor for McGraw-Hill in the Southwest.

2. Systematic selection of economical protective coatings.

3. More efficient and effective use of materials of construction.

Much of the success of the over-all paint program is due to the Paint Committee, a regulating body set up by management. The committee is composed of members from nine interested departments within the Division. Through its group action, aid from the entire plant is enlisted in cutting painting costs. The Paint Committee initiates research, reviews findings, makes recommendations to management, and periodically revises the Division's paint manual.

Dow's paint program, which took over a decade to develop, is founded on the premise that the experiences of others are not valid for all given locales. Coatings and materials must actually be tested at the problem site under service conditions.

Lacking specific information about its own problems, and how

#### **Dow's Corrosion Problems**

Dow's Texas Division is located on the Gulf Coast at Freeport, Tex., and is made up of two plants—Plant "A," about a mile from the beach; and Plant "B," seven miles from the water. When Dow came to Texas in 1940, management expected severe corrosion problems; they were not disappointed. Sealevel elevation and semi-tropical climatic conditions prevail, and atmospheric corrosion—accelerated by salt-laden prevailing winds from the Gulf—is probably as severe as any place in the world.

Since Dow's primary concern was attractiveness, original paint specifications were based primarily on color. Management's desire for good housekeeping called for lots of paint at a time (World War II) when paints, particularly in colors, were not plentiful nor especially

noted for durability.

Paint maintenance costs were therefore staggering, and paint manufacturers were unable to supply suitable materials. Dow, footing the bill, decided that its corrosion problems were beyond the experience of suppliers, and set out to provide its own answers. As a result, manufacturers themselves have learned a great deal about corrosion on the Texas Gulf Coast, and have stepped up their own development programs in search of better, more durable materials.

The size of Dow's paint maintenance program: 272 full-time painters and an annual expense of over

\$1 million.

to solve them, Dow started some "deep digging" for reliable and accurate answers, following two basic lines:

 Research into the causes and occurrence of atmospheric corrosion.

2. Testing, both in lab and field, for the corrosion resistance of practically every type of protective coating and material of construction.

These two phases of the over-all program assume the role of the laboratory in the selection of corrosion-resisting materials and coatings. The pilot plant function, which is later handled by the Main-

tenance Dept., provides large-scale, plant-wide testing of laboratory recommendations. It is carried out under practical working conditions in an effort to prove or disprove lab suggestions. The joint findings of these two groups form the basis for many of the forward steps in painting procedures at the Texas Division.

The research and testing programs, at their outset, had three separate but interrelated objectives:

1. To test and evaluate corrosion-resistant qualities of practically all construction metals and metallic coatings.

2. To find a "corrosion pattern" for the two plants that make up

the Texas Div.

3. To test and evaluate nonmetallic coatings: to find durable, economical materials; to establish a scientific method for selecting paints by environment; and to set up a more systematic painting schedule.

#### Metals Research and Testing

This began in 1947 with a 15-year test of 15 alloys at three widely-separated test sites. One site is about a mile from the Gulf; another is located in the same plant, but at the center of chemical activities, 1½ miles from the Gulf; the third site is located in a residential area, several miles from either plant, in order to get corrosion rates for a typical non-industrial Gulf Coast site.

These tests are literally from A to Z—aluminum to zinc. They evaluate practically all metals of the common alloy families. Hundreds of metal specimens are exposed on special test racks to the ravages of Dow's coastal industrial atmosphere. Periodical weight-loss checks are made on the specimens to determine their rate of corrosion (the 8-yr. check has just been completed).

Findings of these tests, coupled with the results of the Kure Beach test program,\* have established absolute corrosion rates for various alloys, and the economics of using them at this location. They have bolstered Dow's views that, to mean anything to a particular

plant, corrosion rates must be determined for that plant's location.

For example, corrosion rates at Dow's test site about a mile inland have the same relative rating as Kure Beach test specimens only 800 ft. from the ocean. At the central test station in the plant, the relative corrosion rate is considerably more than that of the Kure Beach racks only 80 ft. from the ocean. This is attributed to additional aggravating effects of the more severe industrial environment.

Metallized coatings came into the picture for exhaustive testing in a similar program, supported by actual field tests on working structures in the plants. Object of this testing was to determine the most economical thickness of various metal coatings for the Freeport area. Many combinations of metal, atmosphere, surface preparation and coating thickness were tested, with the results incorporated into the specifications for metallized coatings.

Typically, the tests have proved that hot-dip galvanized steel, coated to a minimum thickness of 2 oz./sq. ft., has excellent resistance and will last three to four years in areas of low-severity corrosion. It will not last in areas with high-severity corrosion without frequent maintenance. Tests have shown, however, that galvanizing (2 oz./sq. ft.), as a base coat, will stretch the life of an initial paint job by 25-50%, even in the

high-severity areas.

Steel with a sprayed-on coating of a less noble metal, such as lead, is theoretically not supposed to work. Theory says that the dissimilar metals will cause galvanic action and corrosion. Dow finds, however, that lead-metallizing is highly successful. Good results are attributed to the formation of protective sulfates and oxides at the metal surface. A coating having a minimum thickness of 8 mils without paint, or 5 mils with a finish coat of paint, is considered very durable.

#### **Corrosion Contours**

In 1953, another series of tests, aimed at finding a plant-wide, quantitative corrosion pattern, was started. The investigators erected 150 wooden poles, each 10 ft. high,

<sup>\*</sup>The Kure Beach test program is a corrosion project underway at the Cape Fear Peninsula, N. C. More than 50 agencies, including manufacturers, the navies of several nations, the ASTM and others are participating.

(see Fig. 1), throughout the plant area. To every pole, eight mild steel, uncoated coupons-two facing in each direction (north, east, south and west)-were attached. All coupons were of identical analyses and from the same heat (batch). Seasonal checkups were made on the coupons, weight losses measured, and corrosion rates calculated in terms of milligrams/ sq. decimeter/day (mdd.). Finally, points of identical corrosion rate were joined to give "corrosion contour" maps (see frontispiece) of the entire division.

These maps pictorially defined the severity limits of corrosive areas and established numerical corrosion rates for these areas. For the first time, there was a definite yardstick by which materials and paint performance could be predicted.

The maps showed, for instance, that the corrosion rate on mild steel fluctuates from 15 to greater than 150 mdd. within the areaquite a variation in demands on materials and paints. At or near extremely corrosive processes, corrosion rates may exceed the rate for the general area; these conditions are highly localized and can be recognized. The investigators also noted that contour lines can be expected to shift slightly with seasonal changes of the prevailing winds. But on the whole, areas are accurately defined and provide the basis for systematic corrosion control.

These findings, linked with findings of the other research and test programs, have resulted in significant changes in painting procedures within the Division. Plant areas are now divided into three categories: mildly corrosive (up to 50 mdd.); aggressive (50-150 mdd.); and severe (over 150 mdd.). Costly durable paints and materials are now correctly specified for areas of high-severity corrosion-where they are needed most-and less costly materials for less corrosive areas. The end result is a minimum of painting costs.

Corrosion-contour work will be continued into the forseeable future in order to keep track of changes resulting from new units, new processes and discontinued or changed processes. This continued work will keep the contour maps of the Division on a current basis and

make future applications of materials even more effective.

#### Paint Research and Testing

The need for paint research and testing is readily illustrated by one of Dow's own experiences: Once, a better and more decorative enamel was needed for caustic drums. Specifications were submitted to a number of paint manufacturers, who returned answering recommendations. The results reflected wide variations in approaches to the problem. Types of vehicles recommended varied from oil, with resin reinforcement, to chlorinated rubber and modified vinyls; drying time ranged from 5 min, to overnight; material costs from 5.5 to 9.3 cents per painted drum: and dry film thickness from 0.3 to 1.5 mils.

This is not an isolated case; many plants can relate similar experiences. Requests for recommendations from several different manufacturers will bring as many different solutions to a specific paint problem, no two being even remotely similar. Obviously, the implication here is that each plant's problems are unique to that plant, and specific experience is needed to solve them.

In 1945, a test program was started in cooperation with a large manufacturer of paints and protective coatings. Here, Dow set out to evaluate paint performances and establish figures specifically applicable to its own plants at Freeport. The program was later expanded to include many other manufacturers. In this way, the Division and many paint manufacturers combined their knowledge and efforts to produce the most mutually satisfying results.

Test panels for this program, hundreds of them, are set up in representative areas throughout both plants. The manufacturer furnishes specially formulated paints and supervises their application to the panels, at measured film thicknesses. Present testing periods run two, three, or more years on all panels. Evaluation records are made and compared by the engineers of both Dow and the manufacturer.

Among the many qualities evaluated are color retention, chalking, resistance to rust and, of course, durability. Color retention is

checked by comparison with nonfading plastic chips, which are kept on file for matching purposes.

One of the first concepts that the tests proved was that there is only one satisfactory method to determine the most economical paint-actual lifetime exposure of that paint under the conditions with which it will be used.

A second concept was that seeminsignificant formulation ingly changes in succeeding lots of paint from a given manufacturer may greatly alter its protective characteristics. Of the original group of samples tested, only 10% was in passable condition at the end of one year; in the fourth group (supposedly identical to the first group), tested two years later, approximately 39% passed the yearend test. This indicated wide variations of paint quality.

Dow now requests manufacturers to supply complete information on their products, as specified by an essential-data sheet. Any formulation change in future lots of paint requires assignment of a new code number by the manufacturer. The new lot is then retested. In this way, Dow becomes aware of the effects of paint formulation changes.

Among other things, the test program emphasized that protection derived from paint coatings is proportional to the film thickness -always assuming proper application. For example, in one test on 70-80 panels, of many types of paints, it was shown that a panel coated to a dried-film thickness of 5.2 mils had over twice the durability of a similar panel coated to a thickness of 2.8 mils. Also demonstrated was the fact that paint life is generally a function of the corrosion resistance of the material coated.

Surface preparations were investigated in one series of tests. An axiom of the painting trade states that surface coatings are only as good as the surface preparation. Dow undertook to find out just what effect various preparations actually have on paint life. The three practical methods of surface preparation—pickling, sand-blasting and wire-brushing—were evaluated.

Dow learned that the added first costs for proper surface preparation are more than paid off by subsequent maintenance savings. The life of coal-tar coatings applied to sand-blasted surfaces can be expected to outlast similar coatings applied to wire-brushed surfaces by a ratio of 3 to 1 or more. Where a 12-month life is experienced by an asphaltic mastic coating over a wire-brushed surface, the same coating on a sand-blasted surface will give an average life of 46 months.

Quantitative proof such as this has led Dow to emphasize surface preparation more than ever. Plant specifications for new steel now call for either sandblasting or pickling, depending on the size of the structural components. The Division op-

erates its own pickling and phosphatizing facilities for small parts. Larger members are sandblasted to bright metal.

In-place cleaning of steel for maintenance painting is, of course, complicated by operating equipment, personnel and the fire hazard. In the few cases where possible, these structures are sand-blasted, but wire-brushing is the mainstay of maintenance painting. Surface preparation is usually followed by two coats of primer and two finish coats of paint, to bring the minimum film thickness to 5.0 mils.

#### **Current Paint Specifications**

The revised paint manual, based on the findings of the program, spells out in detail the painting requirements for all plant areas. To use the manual, which is in general circulation among the Division's supervisors, the area to be painted is first classified as to degree of corrosion severity. The contour maps simplify this task. Surface coating is then specified according to the color required.

Disregarding appearance, the most universal economic coating would be a mixture of two solvent-laden coal tars that are applied cold and cost about 5-10 cents/sq. ft./yr. However, color, for both appearance and identification, is generally the first consideration in the selection of paints for the Texas Div. In general, oleo-resinous paints are specified for areas of mild corrosion and chlorinated rubber or vinyl-based paints for areas of medium corrosion. In severely corrosive areas, only the coal-tar, asphaltic, or vinyl mastics are used.

Specifications are constantly changing as new tests prove new materials and methods. One such change was a switch in paint for a group of steel stacks with skin temperatures up to 500 F. Where most paints last 6-9 months, a change to a silicone-based paint gives 3-4 yr. service. The new material is costly, but in this instance, the great increase in paint life more than pays the 20% differential in material costs.

#### Economics Paves the Way

Each of the examples pointed out in the preceding run-down of the paint program shows some saving in costs; multiplied many times over, they add up to a sizeable percentage of the 7-digit painting tab that Dow picks up each year. And the people most responsible for the painting program—the Paint Committee and Maintenance Dept.—point out that it is attention to detail that spells the success or failure of any such venture.

Costs of galvanizing are, of course, much higher than those of coatings, but in many instances, may be cheaper in the long run. Besides stretching the life of a finish coat of paint, a galvanizing base coat practically eliminates cleaning time and surface preparation for subsequent painting. This assumes that the steel is repainted before the galvanizing coat rusts through. The Texas Div. has determined that the cost of a protective coating consisting of a single coat of hot-dip galvanizing, followed by two coats of paint, will run about 60 cents/sq. ft.; sandblasting, followed by four coats of paint alone, will cost about 40 cents/sq. ft.

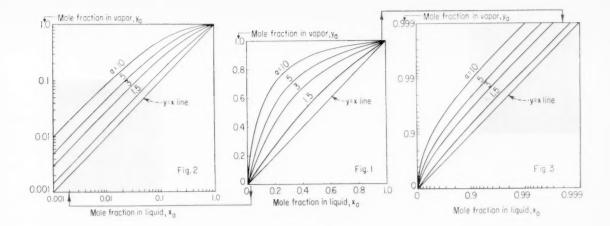
Initial cost, while important, is one thing, but Dow aims for a minimum cost/sq. ft./yr., and the higher first cost is justified many times

At the Gulf Coast site, materials costs run 30-40% of the total painting cost; labor, 60-70%.

Frequency of painting has an important bearing on the unit cost per year. Each paint type has an optimum life depending on its formulation and its environment. Dow schedules repainting to coincide as closely as possible with the ultimate life of a coating. "Repaint just before it's needed" is the bylaw of the maintenance program.

Over the past ten years, the efficiency of many types of coatings has more than doubled as a result of stepped-up research and development programs by the manufacturers. Dow is convinced that the ultimate is still ahead. At present, some 36 different, large-scale tests are underway.

Results of these tests, combined with those of hundreds already completed, when added to the experience of day-to-day observation of paints in service, will continue to build up knowledge of the corrosion problem. While Dow researchers modestly deny being experts in paints and corrosion, no one can doubt that they are experts on Dow's corrosion problems.



For 99.XXX% Pure Products

## Find Distillation Stages Graphically

Use this speedy, simple, accurate method to find theoretical stages in regions of very low and very high concentrations.

#### PAUL J. HORVATH and RICHARD F. SCHUBERT, B. F. Goodrich Chemical Co., Avon Lake, Ohio\*

Here is a method for calculating theoretical plates in distillation columns when extremely high product purities are required—like 99.99 mole %, for example. It's fast and accurate, yet shows you visually the effect of key variables on column performance.

The procedure is a special variation of the McCabe-Thiele graphical method for calculating theoretical plate requirements in binary distillation systems. Primary emphasis is on the ends of a distilling column—where either very high or very low product concentrations are involved.

The standard McCabe-Thiele graphical method, introduced some 30 years ago, has become one of the most widely used techniques in binary distillation calculations. This procedure is popular because it is a simple graphical calculation which permits a high degree of visualization.

For very dilute and very concentrated systems, a crowded condition, or "pinch," results when the method is applied. This makes it physically impossible to calculate the theoretical stage requirements

with an acceptable degree of accuracy on graphs of normal size. In such cases it is possible to resort to large-dimension graphs or to algebraic techniques.<sup>5, 5, 6, 6</sup> Although algebraic methods give a high degree of accuracy, graphical visualization is lost.

The advantages of both visualization and accuracy are retained by plotting the McCabe-Thiele diagram on logarithmic coordinates. Others, 7, 8, 9 have described this method. However, these applications demonstrated the use of log plots only in the dilute or stripping region of operation.

Fowler<sup>10</sup> has shown how the loglog plot can be applied to the concentrated or rectifying section by plotting the diagram in terms of the less volatile component. However, the analogy to the standard McCabe-Thiele diagram is not maintained and some confusion may result.

In this article we show how a log-log plot completely analogous to the usual McCabe-Thiele diagram can be used in both the stripping and the rectifying sections. We will consider the procedure for plotting upper and lower operating

lines, including the effect of opensteam heating on the lower operating line, and we will demonstrate the method of plotting the q line representing the thermal condition of the feed.

Some of the applications of this method include distillation calculations for drying liquid organic chemicals which are partially miscible with water; recovery of solvents from raffinate streams in extraction processes; and production of extremely high purity materials. The method also permits the extrapolation of incomplete vaporliquid equilibrium data into very dilute and very concentrated regions.

#### Method Unfolds

In an ideal binary system, the composition of the vapor  $y_4$  in equilibrium with liquid of composition  $x_a$  is given by the equation:

$$y_a = \frac{\alpha_{ab} x_a}{1 + (\alpha_{ab} - 1) x_a} \tag{1}$$

where a and b refer to the more volatile component and the less volatile component, respectively, and  $a_{ab}$  is the relative volatility of a with

<sup>•</sup> Meet your authors on pp. 178 and 179.

respect to b. For ideal binary systems, the term  $a_{ab}$  is:

$$\begin{aligned} \alpha_{ab} &= \frac{y_a/x_a}{y_b/x_b} \\ &= \frac{y_a/x_a}{(1-y_a)/(1-x_a)} = \frac{p_a}{p_b} \end{aligned} \tag{2}$$

Fig. 1 presents vapor-liquid equilibrium curves for several ideal binary systems on rectangular coordinates. These are plots of Eq. (1), and are typical diagrams used in the standard McCabe-Thiele method.

For intermediate values of  $x_a$  (from 0.01 to 0.95), the equilibrium line represented by Eq. (1) will be curved when plotted on either rectangular or logarithmic coordinates. As  $x_a$  approaches zero, the term

$$\frac{\alpha_{ab}}{1 + (\alpha_{ab} - 1)x_a}$$

in Eq. (1) approaches the value of  $a_{ab}$ . Thus, for very low values of  $x_a$  Eq. (1) becomes:

$$y_a = \alpha_a b x_a \tag{3}$$

In very dilute regions, Eq. (3) plotted on log-log paper results in a straight line with a slope of unity. Fig. 2 illustrates plots of Eqs. (1) and (3) on log-log paper. Note that the equilibrium curves become parallel with slopes of unity at low values of  $x_{\bullet}$  and  $y_{\circ}$ .

From Eq. (2),

$$y_a = \left(\frac{1 - y_a}{1 - x_a}\right) \alpha_a \, b x_a \tag{4}$$

#### Nomenclature \_

- D Distillate rate, moles/hr.
- L Liquid rate, moles/hr.
- p Vapor pressure of a pure component at a given temperature, atm.
- q Heat required to vaporize 1 mole of feed, divided by molal heat of vaporization of the feed, dimensionless.
- V Vapor rate, moles/hr.
- W Bottoms rate, moles/hr.
- x Liquid composition, mole fraction.
- y Vapor composition, mole fraction.

  Relative volatility, dimensionless.
- Subscripts
- a More volatile component.
- b Less volatile component.
- d Distillate.
- f Feed.
- i Intersection of the equilibrium and q lines.
- m Stripping section.
- n Rectifying section.
- s Steam.
- w Bottoms.

By substituting Eq. (4) into Eq. (1) the following expression results:

$$(1 - y_a) = \frac{(1 - x_a)}{1 + (\alpha_{ab} - 1)x_a}$$
 (5)

As  $x_a$  approaches 1, the term  $1 + (a_b - 1)x_a$  approaches the value of  $a_{ab}$ . Thus, Eq. (5) becomes:

$$(1 - y_a) = \frac{(1 - x_a)}{\alpha_{ab}} \tag{6}$$

In very concentrated regions (high values of  $x_a$ ),  $1-y_a$  plotted versus  $1-x_a$  on log-log paper results in a straight line with a slope of unity. By the simple expedient of inverting the graph and marking the axes in terms of  $y_a$  and  $x_a$ , it is possible to obtain a plot analogous to the standard one.

Fig. 3 is a plot of Eqs. (5) and (6). Note that the graph has been inverted from its ordinary position, and the x and y axes are labeled in terms of the more volatile component. Also, the equilibrium line appears above the y=x line as in the usual McCabe-Thiele plot.

#### Stretching Data

If calculations are being made in very dilute or very concentrated regions and sufficient vapor-liquid equilibrium data are lacking, the equilibrium curve may be determined with a single point of data in the vicinity of the appropriate region. A straight line with a slope of 1.0 drawn through the point will define the equilibrium curve for that concentration range.

Judgment must be exercised, however, in determining the point at which the equilibrium curve becomes substantially a straight line. In general, it may be assumed that the equilibrium line is straight with a slope of unity for liquid concentrations of the more volatile component less than 0.01 mole fraction and greater than 0.95 mole fraction.

#### Upper Operating Line

All of the usual simplifying assumptions made for the standard McCabe-Thiele method apply also to the log plot method. These assumptions are inherent in all the derivations and equations below where they are applicable.

In terms of the composition (x, y) of the more volatile component, and with the trays above the feed point

counted downward, the upper operating line equation is:

$$y_{n+1} = L_n x_n / V_n + D x_d / V_n \tag{7}$$

Since a plot of  $x_n$  vs.  $y_{n+1}$  is not a straight line on logarithmic graph paper, several points must be calculated to define the upper operating line. Various values of  $x_n$  along with the known values of  $L_n$ ,  $V_n$ , D, and  $x_4$  are substituted into Eq. (7) to calculate corresponding values of  $y_{n+1}$ .

#### The q Line

To determine the minimum reflux ratio or the maximum stripping ratio; to locate easily the intersection of the upper and lower operating lines; or to find the feed plate vapor and liquid compositions, the thermal condition of the feed must be known. The locus of the point of intersection of the operating lines is given by the equation:

$$y_i = qx_i/(q-1) - x_f/(q-1)$$
 (8)

When  $y_i$  vs.  $x_i$  is plotted on loglog paper, the line is straight for certain feed conditions only (when q=0 and 1). Therefore, it is necessary to substitute various  $x_i$  values into Eq. (8) along with the known quantities q and  $x_i$  to calculate values of  $y_i$ .

#### Lower Operating Line

Counting the trays below the feed point downward, and expressing compositions (x, y) in terms of the more volatile component, the equation for the lower operating line is:

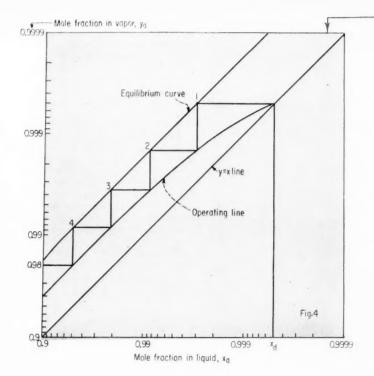
 $y_{m+1} = L_m x_m / V_m - W x_w / V_m$  (9) This is not a straight line when plotted on log-log paper. Thus, several values of  $x_m$  along with the known values of  $L_m$ ,  $V_m$ , W, and  $x_w$  are used to calculate corresponding values of  $y_{m+1}$ . These points are plotted to define the line.

#### Open-Steam Heating

When the bottoms stream is practically pure water, the heat requirements for the operation may be supplied by using open steam in the column.

Here, the equation for the lower operating line is altered to:

 $y_{m+1} = L_m x_m / V_m - W' x_w' / V_m$  (10) where  $W' = W + W_m$ . All other things being equal, the  $L_m / V_m$  ratio



will be the same whether opensteam or indirect heating is used.

If the value of x at the point of intersection of the lower operating line with the y=x line is called  $x_w$ , then

$$x_{\mathbf{o}'} = Wx_{\mathbf{o}}/(W + W_{\mathbf{o}}) = Wx_{\mathbf{o}}/W'$$
 (11)  
When Eq. (11) is substituted into Eq. (10), the result is Eq. (9).

Thus, the operating line for both open-steam and indirect heating is identical down to the point of intersection with the y=x line. At that point the indirect heating line ends, while the open-steam line continues to the point y=0,  $x=x_y$ .

On a log-log plot, the point y=0,  $x=x_{u'}$  is at negative infinity, however, so that only the finite value  $x_{u'}$  can be shown on the diagram. This value actually determines when the bottom of the column is reached, so that the absence of an end to the open-steam lower operating line on log-log paper is not significant.

#### Ratios, As Usual

The minimum reflux ratio and maximum stripping ratio define the operating limit where infinite stages are required for a given separation. The minimum reflux ratio is the slope  $L_n/V_n$  on rectangular coordinates of the upper operating line which passes through point i, the intersection of the q line and the equilibrium curve for ideal systems. The maximum stripping ratio is the slope  $L_m/V_m$  of the lower operating line on rectangular coordinates which passes through the same point.

The minimum reflux ratio can be calculated by substituting the values of  $y_i$ ,  $x_i$ , and  $x_d$  in the following equation:

$$(L_n/V_n)_{min.} = (x_d - y_i)/(x_d - x_i)$$
 (12)

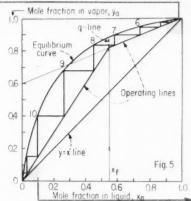
The maximum stripping ratio is calculated in the same manner from the following expression:

$$(L_m/V_m)_{max.} = (y_i - x_w)/(x_i - x_w)$$
 (13)

To determine  $x_i$  and  $y_i$  for ideal systems, Eqs. (1) and (8) may be solved simultaneously. Or, Eq. (8) can be plotted and the point of intersection— $y_i$ ,  $x_i$ —of the q line and equilibrium curve determined.

#### How It's Done

Here is a summary of the Mc-Cabe-Thiele method for calculating the theoretical stage requirements using either rectangular or loga-



rithmic coordinates for plotting the equations:

1. Plot the vapor-liquid equilibrium data, or use Eq. (1) for ideal systems.

2. Mark the feed, bottoms and distillate compositions on the diagram.

3. Plot the q line—Eq. (8)—and determine the value of  $x_4$  and  $y_4$  at its intersection with the equilibrium curve.

4. Calculate the minimum reflux ratio—Eq. (12)—or the maximum stripping ratio—Eq. (13).

5. Choose either an optimum reflux or stripping ratio and plot the upper and lower operating lines—Eqs. (7) and (9), respectively.

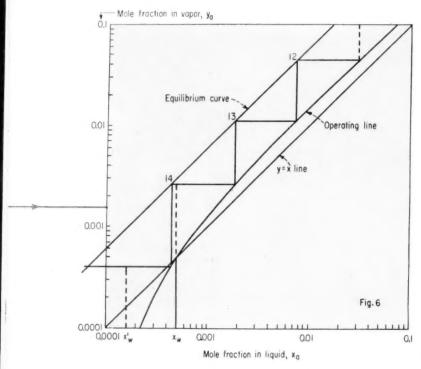
 Start with the maximum liquid composition in the column and draw alternate horizontal and vertical lines between the operating and equilibrium curves until the desired bottoms composition is reached.

7. Count the number of theoretical stages required for the given separation.

#### Seeing Is Believing

A continuous distillation column is required to separate a mixture containing 55 mole % a and 45 mole % b into an overhead product containing 99.95 mole % a and a bottoms product containing 0.05 mole % a. The feed enters the column at its boiling point. For this hypothetical example, assume that component b is water.

Calculate vapor-liquid equilibrium data by assuming  $a_{\bullet \bullet} = 6$ . The optimum reflux ratio  $L_n/V_n$  has been found to be 0.40, which has a corresponding stripping ratio  $L_m/V_n$ 



V<sub>m</sub> of 1.49. From a material balance the ratio  $D/V_m$  is 0.60 and  $W/V_m$  is 0.49.

Calculate the total number of theoretical stages required in the operation for: (1) indirect heating and (2) open-steam heating.

In this problem a logarithmic diagram for both the dilute stripping and the concentrated rectifying sections must be used. The standard McCabe-Thiele diagram on rectangular coordinates will be used in the mid-concentration region.

#### Indirect Heating

1. Vapor-Liquid Equilibrium Data-Eqs. (1), (3), and (6) are used to calculate the vapor-liquid equilibrium data in the concentration regions where they are applicable.

Rectifying Section: Points' below are calculated from Eq. (6) and are plotted in Fig. 4.

Intermediate Region: From Eq. (1), the points below are calculated and plotted in Fig. 5.

Stripping Section: Two points in the dilute region are calculated from Eq. (3) and plotted in Fig. 6.

Mark the values of  $x_t$ ,  $x_v$ , and  $x_d$ on the appropriate diagrams, and plot the q line on Fig. 5. This line is vertical in this case since the feed enters at its boiling point, and q = 1.

2. Upper Operating Line-Insert known values into Eq. (7) to give the upper operating line equation:

$$y_{n+1} = 0.40x_n + 0.5997$$

Substitute various values of  $x_n$ from 0.9995 to 0.9000 into this equation to calculate  $y_{n+1}$  values. Plot these in Fig. 4.

The easiest way to plot this equation in Fig. 5 is to connect the yaxis intercept, 0.5997, with the point  $x_0 = y_0 = 0.9995$  by a straight line.

3. Lower Operating Line-Eq. (9) as determined from the data of this problem is:

$$y_{m+1} = 1.49x_m - 0.0002$$

Substitute values of  $x_m$  from 0.0005 to 0.0100 into the equation and solve for values of  $y_{m+1}$ . Such values are plotted in Fig. 6.

Connect the point of intersection of the q line and the upper operating line with the point  $x_a = y_a =$ 0.0005 to plot the lower operating line in Fig. 5.

4. Theoretical Stages - Start stepping off separation stages at the overhead concentration  $x_4$  on Fig. 4 and continue to the value  $y_{n+1} =$ 0.9800. Locate the point  $y_a = 0.9800$ on the equilibrium curve in Fig. 5. Continue the stepping off process to  $y_{m+1} = 0.045$ . Locate this value on the equilibrium curve in Fig. 6, and continue the stepping to the bottoms composition  $x_w = 0.0005$ .

The total number of theoretical stages required is:

$$13 + \frac{0.00185 - 0.00050}{0.00185 - 0.00044} = 13.96$$

#### Open-steam Heating

The only modification necessary in the previous plots is to continue the lower operating line as near as possible to the value of  $x_{\bullet}$ . In this problem W. may be assumed equal to  $V_m$ . Then,  $(W/V_m) =$  $(W/W_{\bullet}) = 0.49$ . From Eq. (11):

$$x_{\mathbf{w}'} = x_{\mathbf{w}}/(1 + W_{\bullet}/W) = 0.0005/(1 + 1/0.49) = 0.000164$$

Substitute into Eq. (9) values of  $x_m$  that are less than 0.0005 and calculate  $y_{m+1}$  values. Plot these in Fig. 6, and mark  $x_{\omega}'$  on the plot also. Note that the lower operating line approaches  $x_{\mathbf{w}}'$  as a limit.

Step off the remaining steps for this case, and determine the total number of theoretical stages required for this separation with open-steam heating as:

$$14 + \frac{0.000440 - 0.000164}{0.000440 - 0.000069} = 14.75$$

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How to Calculate Adequate

## Spring-Loaded Relief Valves

Here are the factors to consider for correct relief valve discharge under various conditions in process equipment. Capacity formulas show how to find valve area.

#### J. E. BIGHAM, Instrument Superintendent The Chemstrand Corp., Pensacola, Fla.\*

Relief devices provide the necessary overpressure protection to pressure-operated equipment in the chemical process industries. In this article we consider the methods of sizing the spring-loaded type relief valve.

Each pressure relieving installation must be treated as an individual problem. However, to insure uniform protection, we shall standardize relief device selection and calculation. 'The data given here are useful in making preliminary calculations for initial layouts of pressure relieving systems.

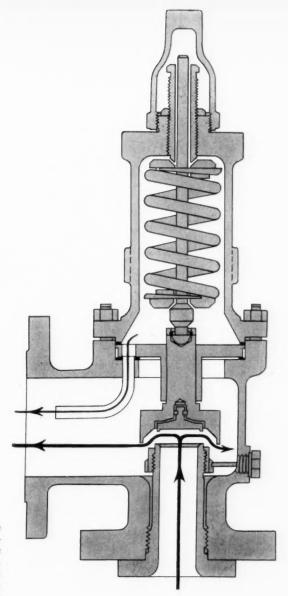
Before discussing the actual sizing of relief valves, let us consider the conditions that are met in various types of equipment which require pressure protection.

For unfired vessels, check pressure relief devices for required relief capacity under the conditions of overhead cooling medium failure; reflux failure; input to vessel with all exits blocked except pressure relief device and fire.

Size pressure relief devices for a minimum capacity equal to or greater than the maximum required relief capacity for the vessel as determined for the worst condition.

If pressure relief devices protect more than one vessel, size the relief devices for the combined duties of all vessels.

\* Meet your author on p. 173.



Compute relieving capacity at allowable percent accumulation from manufacturer's charts and formulas for a particular pressure relief device.

#### Failure of Overhead Cooling

Overhead cooling medium failure applies to any process vessel normally operated so that the overhead product temperature is reduced directly or indirectly by a cooling medium. Where more than one cooling medium is present such as primary cooling with water and secondary cooling with refrigerant, assume that all cooling fails simultaneously.

Determine required pressure relief capacity for total vessel overhead including reflux and recycle streams. Use vessel top temperature adjusted to the absolute relieving pressure and the average molecular weight

#### Apply These Definitions to Relief Systems

#### Accumulation

Maximum allowable accumulation is the percent increase in pressure above the maximum allowable working pressure of the vessel during discharge of the relief device at its required capacity.

Some representative causes of excess pressure and their accumulation percentages are:

Failure of cooling or reflux me-	
diums or both	10%
stoppage in lines leaving ves-	
sels Fire or other external causes.	10%

Where pressure relieving devices protect two or more vessels, allowable accumulation is based on the vessel having the lowest maximum allowable working pressure.

Allowable accumulation for pressure relieving devices operating below maximum allowable working pressure is found as follows:

For relief pressures above and including 80% of maximum allowable working pressure, accumulation may be the percent above the maximum allowable working pressure of the vessel.

For relief pressures below 80% of maximum allowable working pressure, accumulation may be the percent above set pressure of the relief device.

#### Relief Pressure

Relief pressure (psig.) is the actual pressure in the inlet chamber of the pressure relieving device at which the device is designed to start relieving.

Absolute relieving pressure (psia.) is the relief pressure plus the maximum allowable accumulation.

#### Maximum Relief Pressure

Maximum relief pressure of a singly installed device is never more than the maximum allowable working pressure of the vessel.

Vessels connected in a system with common overpressure protection are considered as one unit. Maximum relief pressure is determined by the equipment with the lowest maximum allowable working pressure.

Secondary pressure relieving devices supplemental to primary relieving devices may relieve at 150% of the maximum allowable working pressure. However, primary pressure relieving devices must have sufficient capacity to prevent the pressure from rising above the absolute relieving pressure.

Pressure relieving devices may be installed to protect the process as well as the vessels. Maximum relief pressure lower than the maximum allowable working pressure of the vessel

is permissible.

Where pressure relieving devices are used to protect piping, valves and instrumentation, the relief pressure may be 20% above the maximum allowable working pressure of the weakest member if the pressure is non-pulsating. If the pressure is pulsating, the relief pressure is the maximum allowable working pressure of the weakest member.

#### Minimum Relief Pressure

The minimum relief pressure for relief valves may be 1.175 times normal operating pressure or four psig., whichever is larger. Of course, the minimum relief pressure should not exceed the code rating of the vessel. the vapors and the adjusted temperature and vapor quantity in the charge zone to determine the required relieving capacity.

Where reboilers or heaters provide heat in addition to that supplied by the charge, the relieving capacity of the relief device is the normal charge vapor plus the additional amount of the charge vaporized by the reboiler or heater. Of course, we assume that charge flow and reboiler or heater input remain unchanged. Reboiler vapors plus the charge vapors may be used for the flow quantity.

The molecular weight is the average of the feed vapors and reboiler vapors. Temperature is the normal bottoms temperature adjusted to the absolute relieving pressure.

Simultaneous overhead cooling medium and reflux failure may be assumed as probable only when all fluids are transferred by motor driven pumps. For failure of cooling or reflux mediums or both, calculate the amount of vapors generated. Then determine relief valve area by vapor relief formulas.

#### Relief Device Is Only Exit

We now examine the case where there is input to a vessel with all exits blocked except relief devices. Only flow quantities available at the set pressure of the relief device are considered as input to vessel. Fluids transferred with pressure insufficient to open the relieving device are not considered a source of input.

Reflux and recycle streams are not considered as input except when these streams enter from tankage outside the unit or with storage capacity separated from the column by a valve between the storage capacity and the vessel.

For example: consider reflux as input if there is a valve in the overhead line from a column before the reflux accumulator.

Flow quantity through control valves on input lines is computed as the capacity of the control valve in a wide open position. Pressure drop across the control valve is equal to the maximum pressure available at the inlet of the control valve minus the relief pressure of the relief device.

Consider positive displacement pumps that supply fluids to the vessel as delivering at full capacity up to 1.25 times the relief pressure of the relieving device on the pump

of the total overhead products. Normal external heating quantity may be used. Internal heating quantity such as stripping steam shall be included only if the supply pres-

sure of the heating fluid is higher

than set pressure of relief device. Calculate the quantity of vapors generated and determine the relief valve area by vapor relief capacity formulas.

#### Reflux Failure

In vessels where the source of heat is in the charge or feed to the vessel, required relief capacity may be calculated as though the pressure relief devices were placed immediately above the charge entry zone and the vessel is blocked off above the entry zone. Here, we use the average molecular weight of

discharge and no fluid thereafter.

If centrifugal pumps have a rated discharge pressure above the set pressure of the relief device on the vessel, consider them as a source of input to the vessel.

Maximum quantity of pump input to vessel is that flow necessary to lower the pump discharge pressure to the set pressure of the relief device. Heat input to the vessel may be assumed that of normal operation.

For conditions of blocked exits calculate volume of vapors which may be generated. Determine relief valve area required by vapor relief valve capacity formulas. In most instances, required capacity W is approximately equal to the amount of vapors leaving the vessels during normal operation.

#### Consider Accidental Fires

Whenever accidental external fires occur, heat may be absorbed by pressure vessels and the contents may vaporize. The resulting overpressure then causes the relief valve to open. Thus in determining relief valve size, we must estimate the quantity of vapors generated by this heat input. We can estimate the heat input under these conditions by the following method.

All vertical distances are measured above grade level. Where vessels are on flat roofs or elevated solid platforms, the roof or platform is the grade level. For vessels located inside retaining walls, the top of the retaining wall overflow elevation is the grade level.

Total wetted surface is usually limited to that wetted surface included within a height of 25 ft. above grade. In the case of spheres and spheroids, use the vessel horizontal center line if it is higher. When a vessel is exposed to fire, the surface area which is effective in generating vapor is the area wetted by the internal liquid contents. Under variable level conditions, the liquid contents may be taken at the average inventory.

The rate of vapor formation equals the total rate of heat absorption divided by the latent heat of vaporization. Of course, this is true for pressure and temperature conditions below the critical point of the material. The rate of vapor formation is a measure of the rate of vapor relief required. Here the heat of vaporization is taken at the pressure and temperature corresponding to the accumulated pressure at which the relief device dicharges. When pressure relief conditions are above the critical point, the rate of vapor discharge depends upon the rate at which the fluid expands as a result of the heat input.

We can calculate the heat absorbed by a vessel with the following equation:

$$Q = 21,000FA^{0.82}$$

where Q = total heat input to thewetted surface, But./hr.; A = totalwetted surface, sq. ft.; and F =environment factor (see table on next page).

#### Heat Exchanger Relief Devices

No vapor relief valve is needed if the vapor pressure of the cold fluid is less than the absolute relieving pressure. Vapor pressure of the cold fluid is taken at a temperature equal to the inlet temperature of the hot fluid during maximum available heating conditions.

If the vapor pressure of the cold fluid is greater than the absolute relieving pressure, a relief valve is recommended. Here vapor pressure of the cold fluid is at a temperature equal to the inlet temperature of the hot fluid during normal heating conditions.

If vapor relief valves are used, calculate the amount of vapors to determine relief valve area by vapor relief valve capacity formula.

$$W = \left[\frac{K-1}{K}\right] \left[\frac{T_i - T_b}{T_i - T_o}\right] \frac{H_e}{Sp.Ht}.$$

 $H_{\bullet} = \text{Heat exchanger duty, Btu./hr.} \\ K = \text{Antilog}_{10} \left[ (T_i - T_o)/2.8LMTD \right]$ LMTD = Log mean temperature differ-

ence, deg. F.  $P_1 =$ Absolute relieving pressure,

 $T_b$  = Boiling point of cold side fluid, deg. F. at P1

 $T_i = \text{Inlet temperature on hot side,}$   $\deg. F.$   $T_\sigma = \text{Outlet temperature on hot side,}$ 

deg. F

W = Capacity, lb/hr.

For liquid expansion in exchangers, calculate relief capacity by liquid relief valve capacity for-

$$W = BH_{\bullet}/Sp.Ht.$$

where B = coefficient of thermalexpansion of cold fluid;  $H_e$  = heat exchanger duty, Btu./hr.; Sp. Ht. =specific heat of cold fluid, Btu./lb.-deg. F. and W = capacity, lb./hr.

For internal failure without vapor generation, calculate relief valve area directly by:

$$A = Na \left[ \frac{(P_H + 14.7)}{(1.2P_L + 14.7)} - 1 \right]^{0.5}$$

where allowable accumulation factor is 1.2 and

A =Effective valve area, sq. in. a =Internal cross sectional area of one tube, sq. in.

N = Maximum number of tubes assumedruptured. Use 10% of total or two, whichever is greater.

 $P_H$  = Operating pressure on high pressure side, psig.

 $P_{L}$  = Design pressure on low pressure side, psig.

#### When Mixtures Flash

Where liquids partially vaporize on discharge through a relief valve, several steps are necessary to find the required relieving area. These are (1) determine the quantity of vapor formed by flashing, (2) calculate effective area necessary to relieve the vapor, (3) calculate effective area necessary to relieve the remaining liquid. The total area required to pass the flashing mixture is the sum of the effective areas for relieving vapor and liquid.

Assuming that radiation loss is zero gives us the maximum vaporization. Use either of the following formulas to determine the fraction by weight of liquid vaporizing to

$$\begin{array}{l} x = (H_{f1} - H_{f2})/(H_{g2} - H_{f2}) \\ x = Sp.Ht.(T_1 - T_2)/H_{fg} \end{array}$$

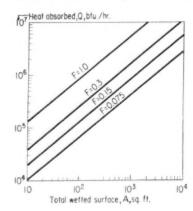
where in consistent units

 $H_{f1}$  = Heat of liquid entering.  $H_{f2}$  = Heat of liquid leaving.  $H_{fg}$  = Latent heat of vapor.

#### Coming . . .

In a forthcoming article, author Bigham discusses rupture disks as relief devices for pressure and vacuum service. He also describes the applications, materials of construction and physical properties of rupture disks for their selection.

#### Heat Absorbed by Vessel Exposed to Fire



Type of Installation	Factor, F
Insulated vessels:	
$Conductance^* = 4.0$	0.3
Conductance $= 2.0$	0.15
Conductance = 1.0	0.075
Bare vessels	1.0

<sup>·</sup> Conductance is Btu./hr.-sq. ft.-deg. F.

For other cases, use formula:  $Q = 21{,}000FA^{0.82}$ 

 $\begin{array}{c} H_{gt} \coloneqq \text{Total heat of vapor.} \\ Sp.Ht. = \text{Specific heat of liquid.} \\ T_1 = \text{Inlet temperature, deg. F.} \\ T_2 = \text{Outlet temperature, deg. F.} \\ x = \text{Liquid vaporized, fraction by weight.} \end{array}$ 

#### **Use These Capacity Formulas**

To calculate the required area for relief valves, use the applicable formulas that follow.

For liquid relief valve capacity,

$$A = \frac{GPM}{C} \left( \frac{S_q}{P_1 - P_2} \right)^{0.5}$$

Here A= effective area, sq. in.; C= constant for relief valve type and percent accumulation; GPM= flow, gpm. at flowing temperature;  $P_1=$  absolute relieving pressure at inlet, psia.;  $P_2=$  discharge pressure at outlet, psia. and  $S_s=$  specific gravity of fluid at flowing temperature.

However, liquid relief valves that have no blow-down adjustment start opening at 100% and are full open at 125% of set pressure. Consider this fact when specifying set pressure so that allowable accumulation is not violated.

To determine the effective area for gas relief nozzle valves, use the capacity formula which follows:

$$A = \frac{CFM}{392 P_1} \left[ (460 + T_f) S_o \right]^{0.5}$$

where A= effective area, sq. in.; CFM= gas to be released, cfm.;  $P_1=$  absolute relieving pressure, psia.;  $S_t=$  specific gravity of gas relieved and  $T_t=$  flowing temperature, deg. F.

Two formulas are given for cal-

culating the effective area of nozzle valves when relieving vapors. Note that the selection of the formula depends on the flow velocity through the valve nozzle.

When the fluid velocity equals the sonic velocity, the formula is

$$A = \frac{W}{306P_1} \left[ \frac{Z(460 + T_f)}{M} \right]^{0.5}$$

Where the critical pressure ratio  $P_z/P_1$  is less than 0.55, the fluid velocity is less than the sonic velocity. The following formula applies:

$$\begin{split} A &= \frac{W}{2,370P_1} \times \\ & \left[ \frac{Z(460 + T_f)/M}{(P_2/P_1)^{1.818} - (P_2/P_1)^{1.899}} \right]^{0.8} \end{split}$$

Here A= effective area, sq. in.; M= molecular weight;  $P_1=$  absolute relieving pressure, psia.;  $P_2=$  outlet pressure, psia.;  $T_f=$  flowing temperature, deg. F.; W= flow, lb./hr. and Z= compressibility factor (when unknown, use Z= 1.0 for safety).

#### Installing Relief Devices

Provide openings in vessel wall for direct and unobstructed flow between the vessel and its relief device. The cross-sectional area of the connection to a vessel must equal or exceed the required area of the relief device. The connection must have sufficient area so as not to restrict flow at full capacity. Also the pressure drop between the vessel and inlet to the relief device shall be less than 2% of the absolute relieving pressure.

When two or more relief devices are on one connection, the internal cross-sectional area of this connection must equal or exceed the sum of inlet area of the relief devices. Install all pressure relief valves with the stem in vertical plane and in a location that is really accessible for inspection and service.

#### Consider Discharge Piping

The design and installation of the discharge lines influence the operating characteristics of relief devices. Some factors to consider are given here.

To minimize back pressure effects on relief devices, install discharge lines in a direct line with a minimum of fittings. The smaller of the following factors is the maximum allowable back pressure for individual discharge lines direct to atmosphere: (1) outlet connection ASA pressure-temperature limits, or (2) ten percent of the allowable accumulated absolute inlet pressure.

Use minimum load on valve in designing discharge piping since continuous high load at elevated temperatures causes piping to creep. This may distort valve body or end connections. Support discharge piping to prevent swaying and vibration during discharge of relief valve. Also provide supports which let piping expand with temperature.

Prevent accumulation in the valve body or discharge piping by providing suitable drains. Make sure discharge pipe has area that equals or exceeds area of outlet connection of relief device.

Vent vapors and gases in accordance with best procedure applicable. Calculate maximum allowable ground concentration for vapors in relation to preservation of life and equipment. Take suitable precautions for safe disposal of liquids in accordance with regulations in your locality.

Terminate discharge lines from relief devices at a location providing the best possible conditions for safe discharge in relation to personnel, equipment and fire hazard.

#### REFERENCES

1. "Recommended Practice for the Design and Construction of Pressure-Relieving Systems in Refineries (Tentative)," American Petroleum Inst., New York

American redocation (1955).

2. "ASME Code for Unfired Pressure Vessels, Section VIII of the ASME Boller and Pressure Vessel Code," ASME, New York (1952).

#### For Mixtures, One of Three Latent Heats Will Dominate

Latent Heat	Industrial Process
$(L_V)_{PT}$	Continuous distillation. Where, on any plate, temperature and pressure both remain constant but composition changes.
$(L_{V})_{P_{x}}$	Batch distillation. Where pressure and composition remain constant, and the temperature varies.
$(L_{V})_{T_{x}}$	Relatively unimportant industrially. Liquid under pressure changes to vapor at a lower pressure.

## **Predict Mixture Heat of Vaporization**

Latent heat of phase change will often pop up in your engineering calculations. Use these reliable methods to stretch out meager data.

#### WALLACE R. GAMBILL, Union Carbide Chemicals Co., Charleston, W. Va.\*

In two earlier articles, we've discussed methods that you can use to predict the latent heat of vaporization of a pure liquid and the change of latent heat with temperature (Chem. Eng., Dec. 1957, p. 261; and Jan. 13, 1958, p. 159). Now, we'll consider mixtures.

By definition,  $L_r$  for a liquid mixture is the difference of the enthalpies of the equilibrium vapor and liquid at a given condition of pressure, temperature and composition.

To formulate the  $L_{\nu}$  value of a mixture, we need this information:

• Enthalpy changes of the vapor at constant temperature or at constant pressure.

 Heats of mixing of the components of the mixture's liquid and vapor phases.

• Some actual latent heat values.

Therefore, it's much more convenient to work with over-all enthalpy correlations when they are

available. (For example, we have good correlations in the literature for petroleum fractions and hydrocarbon mixtures. See chart p. 139.) These two-phase enthalpy plots are generally well substantiated for the compound classes for which they exist.

We'll do no more than mention these charts in passing, since they fall under the heading of specific data on properties of materials and it is the intention of this series to highlight prediction methods that can be used to estimate engineering properties when specific property data are not available.

#### Consider These Three

Actually, there are three different latent heats to consider in the vaporization process; each corresponds to a different mechanism of vaporization. They are:

1. Differential or equilibrium latent heat,  $(L_r)_{rr}$ . This quantity is at constant pressure and temperature and represents the heat effect for the evaporation of a dif-

ferential amount of liquid to produce the equilibrium vapor. It may be thought of as the heat necessary to produce a mole of vapor of composition y from an amount of liquid so large that its composition, x (the equilibrium value of y), is not appreciably altered by the loss.

This latent heat applies, for example, to each plate of a continuous distillation column, where y is not equal to x; but where both y and x are constant. (An exception is the case of an azeotrope. Here y does equal x.)

2. Integral isobaric latent heat,  $(L_r)_{Fs}$ . This quantity is at constant pressure and composition.  $(L_r)_{Fs}$  applies to the complete vaporization of the liquid under these conditions. The temperature of the system will rise from the bubble point to the dew point, so that the temperature of the final vapor is greater than that of the original liquid. (Exception again is the case of an azeotrope.) A batch distillation or flash vaporization, where y = x, would embody this quantity.

<sup>•</sup>Mr. Gambill is now with the Union Carbide Nuclear Co., Oak Ridge, Tenn. To meet your author see p. 173.

3. Integral isothermal latent heat,  $(L_r)_{\tau_x}$ . This quantity is at constant temperature and composition. It is relatively unimportant from the industrial point of view. The total pressure of the final vapor is less than that of the initial liquid, having fallen from the bubble point pressure to the dew-point pressure.

#### **Methods for Estimating**

Excellent general discussions of relations for calculating latent heats of mixtures have been presented by Dodge ["Chemical Engineering Thermodynamics," pp. 392-394, McGraw-Hill Book Co., Inc., New York, 1944]; Strickland and Constable [Proc. Royal Soc. (London), Vol. A-209, pp. 14-27 (1951)]; and by Schroeder and Edmister in an AIChE preprint.

In our discussion below, we'll present the simplest and most practical equations first; then, a discussion of the rigorous equations derived from thermodynamics will follow. The simple approximation equations are obtainable from the rigorous thermodynamic formulas by the introduction of somewhat restrictive simplifying assumptions.

We'll also include a discussion of applications to azeotropes; solutions of nonvolatile solutes; and petroleum fractions.

#### Some Are Too Good

Several relations of fair-to-excellent accuracy are not treated here because of the unusual correlating variables used in them. For example, Niini in an English language paper published in Ann. Acad. Sci. Fennicae, Ser. A, I, No. 121, pp. 1-12 (1953) presented a correlation for  $(L_r)_{rr}$  of nonpolar binary mixtures of infinite dilution of the solute. This correlation involves—in addition to density data and molar refractions—the ionization energies of the molecules.

Though the average deviation for six dilute mixtures of CS<sub>2</sub>, CCl, and C<sub>n</sub>H<sub>e</sub> is only 0.8%, it's clear that the data required for solving the correlation equation are beyond the scope of engineering calculations.

This sort of thing occurs quite often in the literature of physical property correlation and makes for some interesting relations. (*Lr*, for example, has been related to the acoustic velocity of the vapor!)

#### The Simplest Forms

Simplified correlations for  $L_v$  of mixtures have been given this way:

$$(L_V)_{Px} = (L_V)_1 x_1 + (L_V)_2 x_2 + \cdots$$
 (1)  
 $(L_V)_{PT} = (L_V)_1 y_1 + (L_V)_2 y_2 + \cdots$  (2)

where liquid fractions, x, and vapor fractions, y, are weight or molar fractions, depending on the units of the component latent heats,  $(L_r)_1$ ,  $(L_r)_2$ , etc.

For mixtures of organic compounds only, these approximate simplified forms will usually represent the data within plus or minus 5%. For other mixtures and extreme temperature-pressure conditions, the error can be quite high.

It has been suggested that for immiscible mixtures the component latent heats in Eq. (1) be taken at the component's vapor pressure and the equivalent boiling point of the mixture; whereas, for miscible mixtures, the component latent heats should be evaluated at the total pressure and the boiling point of the component equivalent to this pressure.

#### More Rigorous Forms

Differential or equilibrium latent heat,  $(L_r)_{rr}$ , is directly related to the vapor pressure of the mixture by the Clapeyron equation:

$$(L_V)_{PT} = T \Delta V (dP/dT)_x \tag{3}$$

where the subscript x denotes constant liquid composition.

This form of the equation has little practical use for these two reasons:

• The vapor pressure-temperature relation at constant composition must be known to obtain  $(dP/dT)_x$  at the desired value of x. If this relation is not known as part of the normal phase data of the system, it must be calculated from activity coefficients of the liquid-phase components.

• Evaluation of  $\Delta V$  requires experimental knowledge of the conjugate liquid and vapor densities at the given temperature, pressure and composition; or calculation of the partial volumes for the various components of each phase. Such information is very rarely known and calculable only with difficulty.

Accordingly,  $(L_r)_{PT}$  is ordinarily calculated from an equation that relates it to pure-component heats of vaporization, mole fractions, heats of solution or mixing and enthalpy changes of isothermal va-

por compression or expansion. Vrevsky [Zeit. Phys. Chem., Vol. A 144, p. 359 (1929)] considered a reversible cycle for producing a differential heat effect and arrived at the following for a liquid mixture:

 $(L_V)_{PT} = [(L_V)_1 y_1 + (L_V)_2 (1 - y_1)] - [\Delta H_m + \Delta h_m - (y_1 - x_1)(d\Delta H_m/dx)_{x1}]$  where  $(L_V)_1$  and  $(L_V)_2$  are taken at the constant mixture temperature;  $y_1$  is the equilibrium vapor-phase mole fraction of component 1;  $\Delta H_m = \text{heat of mixing to form liquid of composition } x_1$ ;  $\Delta h_m = \text{heat of mixing to form vapor of composition } y_1$ ; and the expression

 $(d \Delta H_m/dx)_{x1}$ 

is the rate of change of liquid-phase heat of mixing with composition at composition  $x_{i}$ .

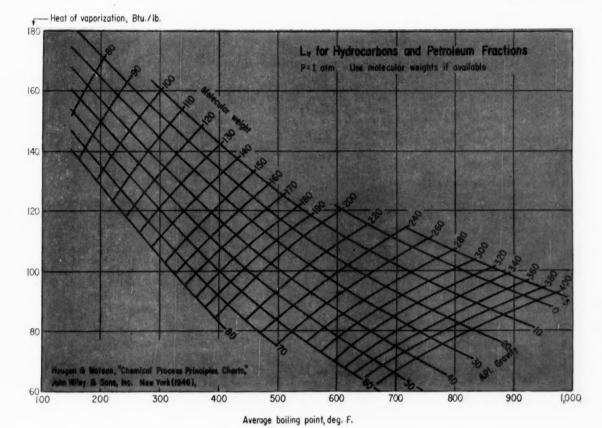
This relation neglects the very small enthalpy change due to isothermal vapor compression. The term for rate of change of liquid-phase heat of mixing may be significant at low concentrations—where the difference in compositions of liquid and vapor is largest—but it will not ordinarily exceed 5 cal./gram in this range. The term  $\Delta h_m$  is negligible except at very high pressures; even very small effects are absent below 10 atm.

Further,  $\Delta H_m$  at the boiling point rarely exceeds about 5 cal./gram. For the  $C_z$   $H_z$  OH— $H_zO$  system, for example, the maximum value is about 3 cal./gram of solution for the usual distillation-temperature range. For electrolytic salts dissolved in a solvent, of course, heats of solution as high as 20,000 gramcal. may be encountered.

So, if the three "correction terms" within the second set of brackets in the above equation are neglected, we simplify to Eq. (2), which is satisfactory except for precise work or in exceptional cases.

Of course, vapor-liquid equilibria data must be known or calculated to find the vapor-phase mole fractions in Eq. (2). In summary, simplified Eq. (2) is based on the assumption of ideal liquid and vapor phases.

The integral isobaric latent heat  $(L_r)_{r,n}$  can be estimated in this fashion. Assume an ideal-solution vapor phase  $(\Delta h_m = \text{zero})$  and that the temperature range of the vaporization process is small enough for the heat capacities to be taken as effective constants. Then, for a binary mixture, and with the vapor choice of datum planes:



$$(L_V)_{Ps} = [(L_V)_1 x_1 + (L_V)_2 (1 - x_1)] + (C_{Pv})_s (T_3 - T_1) + \Delta H_m$$

where  $(C_{P_r})x$  is heat capacity at constant pressure of the mixed vapor of composition x at  $(T_1 + T_2)/2$ ;  $T_1$  is the bubble-point temperature of the solution at the given pressure and composition;  $T_2$  is the dewpoint temperature of solution at the given pressure and composition;  $\Delta H_m$  is the heat of mixing of the liquid at  $T_1$ ; and where  $(L_r)_1$  and  $(L_r)_2$  are for the pure components at  $T_1$ .

If the component latent heats were evaluated at the solution pressure, instead of at  $T_i$ , a considerably lengthier equation would be required. It would involve the purecomponent boiling points and liquidand vapor-phase heat capacities.

Assuming an ideal-solution liquid phase ( $\Delta H_m = \text{zero}$ ), and neglecting the sensible heat term since it's usually small compared to the latent heats—we can simplify to Eq. (1). For organic solutions, the  $(T_s-T_1)$  term is usually less than  $10^{\circ}\mathrm{C}$ , and since the numerical value of  $C_{PT}$  is approximately equal to 0.5, the term

$$(C_{Pv})_z(T_2-T_1)$$

is usually less than or equal to 5 cal./gram.

As long as very soluble gases or inorganic salts are not the solutes, Eq. (1) should be sufficiently accurate for the usual engineering calculations.

Various investigators have measured constant-pressure heats of vaporization. Results may be found in the papers of Talmadge, Schroeder and co-workers in *Chem. Eng. Progress Symposium Series*, No. 10, p. 137 (1954) for benzene-methanol mixtures; and of Plewes, Jardine and Butler in *Can. J. of Technology*, Vol. 32, p. 133 (1954) for binary mixtures of water with methanol, ethanol and propanol.

The integral isothermal latent heat,  $(L_r)_{\tau s}$  may be calculated from this equation:

$$(L_V)_{Tx} = [(L_V)_1 x_1 + (L_V)_2 (1 - x_1)] + [\Delta H_m - \Delta h_m]$$

where the notation is the same as that given previously.

#### Edmister's Proposal

Edmister ("Applications of Thermodynamics to Hydrocarbon Processing, Part XIV, Petroleum Refiner, Dec. 1948) proposed an interesting scheme for calculating the latent heats of mixtures which takes into account all of the variables other than heats of mixing.

We refer you to the original publication for details of the method. But briefly, a latent heat for an equivalent pure component is calculated first. Then, a VdP correction term for pressure change in the isothermal vaporization process is added. The VdP evaluation is in terms of the compressibility factor, and the final relation is stated in reduced form. It is applied to mixtures by use of the pseudo-critical

concept and is recommended for use up to a reduced temperature of about 0.9.

As yet, we have not worked with this method, but it deserves further study and evaluation.

#### **Methods for Azeotropes**

Licht and Denzler in *Chem. Eng. Progress*, Vol. 44, pp. 627-638 (1948) have presented a thorough study of the variation of azeotrope boiling points and latent heats of vaporization with pressure.

Relatively wide ranges of operating pressures used in azeotropic distillations requires a knowledge of this variation.

The behavior of azeotropes is in many respects analogous to that of a single component, and the same vapor-pressure and latent-heat relations hold for azeotropes as for single components. This fact gives rise to the "single-component theory" tested by Licht and Denzler. Within the range of pressure and temperature over which azeotropism exists in the system, this approach is quite satisfactory.

Simply, you can treat a constantboiling mixture as you would a single component; but don't do so for extrapolated pressures and temperatures which are above or below the limits of existence of azeotropism in the system.

In terms of our previous discussion of the various kinds of latent heats for liquid mixtures,  $x_1 = x_2$ ,  $T_1 = T_2$ , and therefore,

$$(L_V)_{PT} = (L_V)_{Pz} = (L_V)_{Tz}$$

as for a pure component.

Licht and Denzler, in checking the available data for 18 two-component and for four three-component azeotropes, found that atmospheric-pressure latent heats calculated from Eq. (2) above agree with the mean of those calculated from Duhring and Othmer plots within 2.5%, on the average. Exceptions are the HCI-H<sub>2</sub>O and HBr-H<sub>2</sub>O systems, which exhibit large liquid-phase heats of solution.

In this calculation it doesn't seem to matter much whether the pure-component latent heats of vaporization in Eq. (1) are taken at the same pressure as the vapor pressure of the azetrope or at the same temperature as the boiling point of the azeotrope. There is an average difference of 1.6%, maximum of 3.0%, in the calculated azeotrope latent heat.

To correlate their data, Licht and Denzler use both a specific heat of vaporization,  $l_r$  (calories of heat absorbed in formation of 1 gram of vapor phase from appropriate amounts of liquid phases at the equilibrium temperature), and a fictitious molar latent heat,  $L_r$ . Molar latent heat is equal to  $M_r l_r$ , where  $M_r$  is the average molecular weight of the vapor phase, which varies with pressure since a change of pressure changes composition. The results are also generalized for multicomponent mixtures.

It's also possible to calculate values of  $L_v$  from Duhring or Othmer plots without a knowledge of the composition of the azeotropic mixture, whereas the component concentrations are required for the use of Eq. (2). With the plots, the latent heats can be determined as unique single-valued functions of Por T, even though the phase compositions of the azeotrope shift continuously with changing pressure.

#### For Nonvolatile Solutes

The case of evaporation of a volatile solvent from a solution that contains a nonvolatile solute is important in the design of evaporators. The heat effect associated with the vaporization of water from an aqueous solution of an inorganic salt is a common example.

If sensible-heat differences are neglected:

$$(L_V)_S = (L_V)_{So} + \frac{x_1x_2}{(x_2 - x_1)} (\Delta H_{S1} - \Delta H_{S2})$$
 (3)

where  $(L_r)_s$  is the latent heat (at constant pressure) of solvent from solution of initial mole fraction  $x_1$  of solute to produce a solution of solute mole fraction  $x_2$ , where  $x_3$  is greater than  $x_1$ ;  $(L_r)_s$ , is the latent heat of pure solvent at the pressure of the solution;  $\Delta H_{s_1}$  and  $\Delta H_{s_2}$  are integral heats of solution per mole of solute for solutions 1 and 2.

Generally, the effect of solute additions in altering the pure solvent's latent heat becomes significant at a boiling-point elevation of about 5 deg. F.

Alternatively, Duhring's rule may be applied in this case. If boiling point of the reference substance (use water for aqueous solutions) is plotted as ordinate vs. that of the solution under consideration as abscissa, each boiling point at the same pressure for each point, the following relation applies:

$$L_V = (L_V)_R \left(\frac{T}{T_R}\right)^2 \left(\frac{dT_R}{dT}\right) \quad (4)$$

where  $L_r$  and  $(L_r)_R$  are the molar latent heats of solution and of reference substance, respectively, at the same pressure; T and  $T_R$  are boiling points of solution and reference substance, respectively, at the same pressure (absolute temperature scale); and  $dT_R/dT$  is the average slope of the Duhring line.

This equation is satisfactory for moderately concentrated solutions in the low-pressure range; for high concentrations, the curves depart markedly from straight lines.

Othmer in Ind. & Eng. Chem., Vol. 32, p. 841 (1940), showed that by plotting vapor pressure of given substance vs. vapor pressure of a reference substance at the same temperature on log-log coordinates, one obtains a straighter line (more constant slope) which improves the accuracy of the calculation.

#### For Petroleum Mixtures

For the important special case of the petroleum oils, Cragoe proposed the following relation:

$$L_V = (1/s_i)(110.9 - 0.09t)$$

where  $L_v$  is in Btu./lb.;  $s_1$  is specific gravity of the liquid at 60/60 F.; and t is temperature in deg. F.

The experimental range covered by Cragoe in his comparison with data for several petroleum distillates—and for 11 pure hydrocarbons—was: s<sub>1</sub> of 0.64 to 0.91 and t from 100 to 600 F. The estimated accuracy of this equation is 10% for vaporization occurring at sensibly constant temperature and at pressures below 4 atm. abs., without chemical change.

At pressures above 4 atm. abs., this inaccuracy of the prediction increases rapidly. The greater the average molecular weight, the higher the reduced pressure below which the error is less than 10%.

Also, see Maxwell's "Data Book on Hydrocarbons," D. Van Nostrand & Co., Princeton, N. J., pp. 76-77 for a method of approximating the latent heat of vaporization of hydrocarbon mixtures; and the chart on the previous page which we have reproduced from Hougen and Watson's "Chemical Process Principle Charts," John Wiley & Sons, Inc., New York (1946).

# How to Start a Standards Program

Monsanto's standardization program, begun in 1953, is now bearing fruit. How they started—half the battle—is told in this article. Some of the results will be told later.

#### D. C. BRAND and C. W. SISLER, Engineering Dept., Monsanto Chemical Co., St. Louis, Mo.\*

CTANDARDIZATION is not new at Monsanto. Since the company was established just after the turn of the century, standards were adopted in one form or another, first in the parent plant in St. Louis, then in other plants and divisions as the company grew into a worldwide organization. There are records of paint standards for the John F. Queeny Plant, extending back to 1917. These provide quaint reading in this era of specialty coatings. Piping standards for several plants are more recent, dating back to 1935.

Early standards were usually based upon independent judgment factors of engineers and foremen employed in the various plants. They might be altered or even discarded with each change in plant administration. There is evidence that at least several new administrations reviewed the totality of standards experience which preceded them as a guide for contemporary application. However, there is little evidence of effort toward centralized control. Several attempts usually verbal and often unrecorded, were made to coordinate plant standards with plant purchasing policies.

#### Period of Adolescence

There were several reasons why a centralized standards program could hardly succeed during the early years of Monsanto's history. The basic reasons were growth and rapid expansion.

During this period the company concentrated on developing new products and new processes. In short, it was manufacturing chemicals with all its cost consciousness focused on raw materials and low capital investment. The technology of mechanical engineering in chemical plants was embryonic; the economic advantages of standard equipment and parts interchangeability were largely unconsidered; preventive maintenance was still an untested theory.

Monsanto was not unique in its expansion during this period which saw the entire chemical industry

Your Stake in Standards

Standardization applied specifically to the chemical process industries is relatively new. This is the first of a series of articles being planned to consider several aspects of the subject such as (1) How to get started in standards; (2) what can be standardized; and (3) what savings and other benefits come from standardization,

Standards can be classed as external—industry-wide standards covering such matters as screw and pipe threads, pipe, valves and fittings, and drafting and engineering symbols. These have long been familiar in many areas. Then there are internal standards set up by individual chemical process companies to simplify and reduce the cost of their own operations. In the main, these are a postwar development.

Internal standards generally encompass such matters as specifications, equipment designs, and ways of doing things. For example, Monsanto recognizes six types of internal standards: (1) Standard engineering specifications; (2) design standards; (3) engineering standards; (4) standard methods and procedures; (5) inspection standards; and (6) standard engineering and stores specs.—

come of age. An intense concentration upon growth and expansion characterized many of the major chemical companies during the first decades of the century. It is dangerous to generalize from inadequate data, but we suspect that equipment selection and maintenance precedents were established at this time which set the pattern for costly and inefficient procedures in the years immediately following.

By the latter part of the 1930's there was a growing maturity. The war economy of this period demanded capacity production and brought an awareness that a change in thinking was needed within the industry. This awareness became a conviction when, with new construction severely limited, production capacities of existing plants were taxed to the limit by constantly increasing sales. In addition, continuous processes were coming into focus, placing shutdown time at a premium. Repair time assumed a new importance.

In order to protect production, equipment parts inventories soared to new heights. The ingenuity of engineers was challenged by each equipment breakdown because of the need for adapting interchangeability and dependability from parts not necessarily manufactured for the damaged or worn equipment item. In short, both the criteria for quality and the maintenance practices were brought forcefully into the limelight—and found wanting.

#### Period of Introspection

Continued high production at the end of the war focused attention on a dilemma faced not only by Monsanto, but by other chemical producers. High inventories were essential to protect the multiplicity of equipment against the need of high production. Yet, both high production and low storeroom inventories were considered essential.

<sup>•</sup> Mr. Brand is Coordinator of Standards and Mr. Sisler is Staff Engineer of the Standards Section. Meet your authors on pages 176-177.

Events leading up to this dilemma had been complicated. Company expansion had been continued and wartime goals had been reached in a satisfactory manner. Effective work had been done by men who moved toward their goals. So, in undertaking a detailed study of the problem, it was necessary to avoid preconceived ideas or the assumption of a kind of prescience regarding results of actions others had taken. Our study was based on the premise that to understand the reasons why we acted as we did was more important than to speculate on what might have been.

The study of what had gone before defined a complex problem:

1. Exercise of independent judgment by many people over many vears had resulted in a great variety of brands, styles, types, shapes and sizes of mechanical equipment items. To illustrate the situation, one plant had installed approximately 1,200 pumps of 425 different styles, with more than 100 manufacturers represented. Storeroom inventory could not carry a complete coverage of spares and parts for all of these various pumps, yet the total storeroom inventory had reached a peak where reduction was mandatory. The situation was compounded when we found that pressure vessels, agitation equipment, and the entire range of mechanical equipment and materials, also shared a common lack of coordination in selection methods.

2. Multiple styles of similar equipment prevented interchangeability in mounting dimensions and methods. This is expensive from the standpoint of inventories, as well as in maintenance cost and

production loss.

3. Interchangeability of equipment, parts and spares between equipment within a plant—let alone between plants—was next to impossible because of the lack of common dimensional, design, engineering, and specification standards. A plant needing a pump replacement could seldom obtain the replacement from another plant with a large inventory of pumps of similar capacity because of dimensional differences.

4. In addition, there was an inadequate technology for research and evaluation of equipment and materials. Damaged materials and equipment were being replaced with like materials and equipment, with scant attention to the possibility of cost reduction through increased service life from more suitable materials and equipment.

5. Engineering activity was conducted independently on central, divisional, and plant levels, with little intercommunication of ideas.

6. Purchasing of equipment and materials depended upon the specific requests of engineers. Sources of supply were usually selected according to engineering preference. A lack of equipment and materials specifications hampered purchasing activity.

#### Period of Resolution

These studies reported both definitive and broad concepts of standardization. The report suggested that a central standards program might serve to solve the existing problem, while providing a broad base for concepts which would prevent recurrence of the problem. On the recommendation that such a program be attempted, management granted approval, and the general engineering department was authorized to formulate and implement the program. Formal operation of the Monsanto standards program began on January 1, 1953.

The stated objective of the program as it was set up was cost reduction. This was to be achieved through control of stores inventories, through savings in design time and cost, savings in maintenance time and cost, and through development of specifications for use by the purchasing department.

#### Period of Fulfillment

Monsanto's progress in standardization is the result of evolution from a broad field of uncoordinated effort, based upon custom and independent judgment; through a period of standardization by adjudication; toward standardization based upon evaluation and cost comparison reached by participation of representative personnel from all levels of company activity. The basis for selection of standards subjects has evolved from an initial consideration of several factors of cost reduction, to a broader consideration of economic advantage to the company. Priorities for the study of various aspects have been established according to the expected return on our investment in time and effort.

The years immediately following inception of the program were a transition period during which we learned much about the methods of implementation, the scope of application, and the real objectives of our efforts. Our philosophy of standardization in 1953 was necessarily based almost entirely upon Monsanto experience and custom. We learned that plant precedent and authority were highly prized, and that there was a tendency to resent the issuance of central standards which might be suspected of contravening local decision. Centralized standardization had to be slowly and patiently explained.

Since the theory of equipment and material selection on the basis of evaluation, comparison, and extended service life had not yet gained wide acceptance, the Central Standards Group became a standards-writing agency. Early effort of the group was mainly concerned with compiling a guide for technical practice. We then turned toward Standard Engineering and Stores Specifications. We established a system of study, review and final approval of proposed standards which enabled plant, divisional and central personnel to have equal voice in considering merit and application.

The program continued to evolve, with flexibility in meeting objections to the method, pace and scope of implementation which arose from time to time. Initially, there was a skeptical acceptance of the program. However, with time, plants and divisions began to request that the program be accelerated along certain specialized lines to assist in controlling their rising costs.

By the end of 1956, evolution and acceptance of the program had altered the position of the Central Standards Group from that of a standards-writing agency, to a coordinating medium which set procedure, handled costs, and coordinated standardization activity. Study, evaluation and actual writing of the standards had now become the responsibilities of committees with representatives from each company division in various engineering fields such as piping, tanks and pressure vessels, protective coatings, electrical equipment, and so on. Control over the total program was exercised by a strong Central Standards Committee made up of top management personnel.

By now, technical specialists familiar with scientific theory and practice in each of the various fields of engineering application were providing staff assistance to the working committee. Adequate coordination and good communications were insured by having on each of the working committees a member of the Central Standards Group which was also responsible for indexing, numbering, publishing, compiling into manual form, and distributing the approved standards. During the five years of its operation, the program has made definite progress; accelerated progress, we feel, can be anticipated for the immediate future.

#### An Industry-Wide Trend

During the transition period, Monsanto's efforts have been aided and abetted by industry-wide standardization efforts. Monsanto has, in turn, participated in and enthusiastically supported industry-wide attempts at standardization.

Examples of industrial cooperation in standardization include the formation of a Chemical Industry Advisory Board within the American Standards Association in 1950, and of a Mechanical Technical Committee within the Manufacturing Chemists' Association, in 1956.

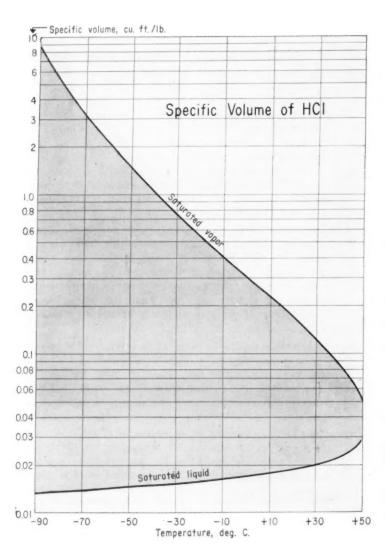
Recognition of problems peculiar to the chemical industry is illustrated by services of the American Society for Testing Materials in providing materials standards. The same is true of efforts of the National Association of Corrosion Engineers toward the mitigation of corrosion. Protective coatings societies have been formed in ten major chemical industrial areas for disseminating cost-reduction information in the coatings field. Activity by various committees of the American Society of Mechanical Engineers toward standard utilities equipment and procedures has been both considerable and helpful.

Beneficial results to be expected from industrial cooperation in the field of equipment standardization are best illustrated by the recent ASA project to provide standards for pumps used in the chemical industry. This project is under the supervision of the Chemical Industry Advisory Board of ASA and is expected eventually to save the chemical industry alone some \$6,800,000 annually.

#### What Monsanto's Standards Accomplish

- With the development of standards within its own organization and with its active participation in industry-wide standardization activities, Monsanto's standards-program objectives have broadened. The past five years has shown that standards provide many advantages:
- Standards can free engineers for more creative work on special problems—important in these days of technical manpower shortages. They make this possible by:
  - · Providing predesigned equipment for run-of-mill use.
  - · Providing prepared specifications for average needs.
  - · Providing preselected equipment for given needs.
  - Providing charts, tables, dimensioning and symbolic data for certain design items.
  - Reducing duplication of effort by central, divisional and plant engineering organizations through coordination of standardization activities.
- Standards can aid in purchasing by proving a basis for flexibility in purchasing department activities. They detail for the manufacturer the acceptable limits of each item standardized. They permit purchases to be made on the basis of standard specifications rather than independent judgment. Standards may eventually provide a basis for competitive bidding on annual contracts of standard items on estimated quantities.
- Standards reduce capital investment in new projects. Savings in engineering and design time, speedier construction, reduction in cost through purchasing flexibility, along with decreased inspection effort, are all anticipated results. Standardization makes possible less costly start-up and adjustment periods for new installations.
- Standards save investment in storeroom inventory. Standard mounting dimensions for equipment which allow interchangeability, reduction in the variety of equipment items, longer service life, are all expected results of standardization. Ease of exchange of spares and parts between plants is another potential benefit.
- Standards cut down the needed investment in maintenance and repair dollars. Standard designs, improved standard equipment with longer service life as replacement items, interchangeable parts, evaluated standard coatings, linings, insulation and piping, coupled with fewer items to learn and become familiar with, should speed training, lengthen intervals between repairs, and reduce costs.
- Standards make safe material and equipment a prime consideration in standards evaluation.
- Standards shorten lines of communication from top management, down the line to the hourly workers. They become media which express the common goal of all company employees—to produce more and better products, safely and at minimum cost.

# Thermal Data for Chlorine and HCl



#### Adiabatic Compression of Chlorine—Compare Data

	P 1,	Ps	T 1,	T 20	Work,
	Psia.	Psia.	Deg. F.	Deg. F.	Btu./Lb.
Present work	14.7	115	-30	260	31.5
Hulme	14.7	115	-30	280	36.0
Ziegler	14.7	115	-30	250	30.5
Perfect gas	14.7	115	-30	240	31.6
Present work	14.7	50	+80	270	21.5
Hulme	14.7	50	+80	280	23.5
Ziegler	14.7	50	+80	260	21.4
Perfect gas	14.7	50	+80	260	21.4

#### C. J. DOBRATZ

#### Dow Chem. Co., Pittsburg, Calif.

(Meet your author on page 174.)

N DESIGNING for operations involving chlorine and HCl—engineers and operating men have found a lack of basic thermal data in a useful form.

Pressure-enthalpy diagrams have been prepared for both hydrogen chloride and chlorine that place the data in a readily usable form.

#### Hydrogen Chloride

Calculations for the diagram were made by use of generalized enthalpy and entropy, correction charts.

Basic engineering data required for the calculations were: One value for the heat of vaporization; heat capacity of the gas as a function of temperature; critical temperature and pressure; and the vapor pressure as a function of temperature.

Specific volumes for saturated hydrogen chloride have also been calculated and are included.

#### Chlorine

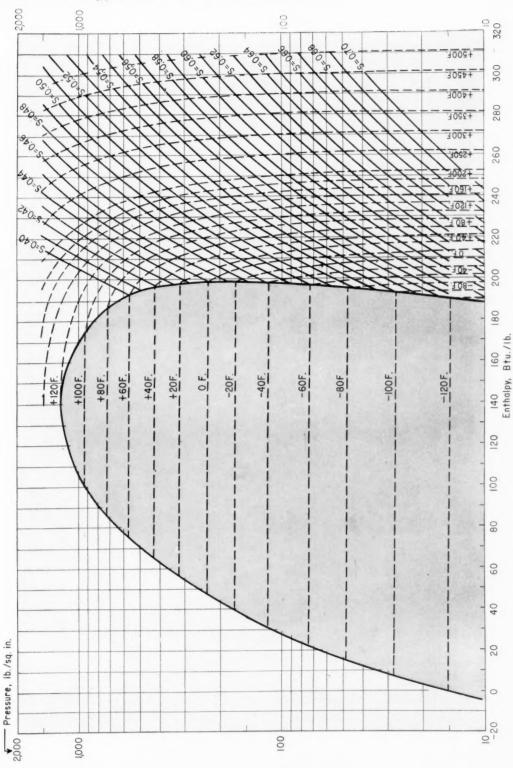
Thermodynamic properties of chlorine have been presented in the literature previously 2, 8 but as mentioned earlier, they are not in a useful form. Preparation of the conventional pressure - enthalpy chart for chlorine was similar to the steps required for HCl.

Values for temperature changes and the theoretical work involved in an adiabatic compression of chlorine gas were computed from the pressure-enthalpy chart. These are compared with values computed from the data of Ziegler and of Hulme and Tilman' in the accompanying table.

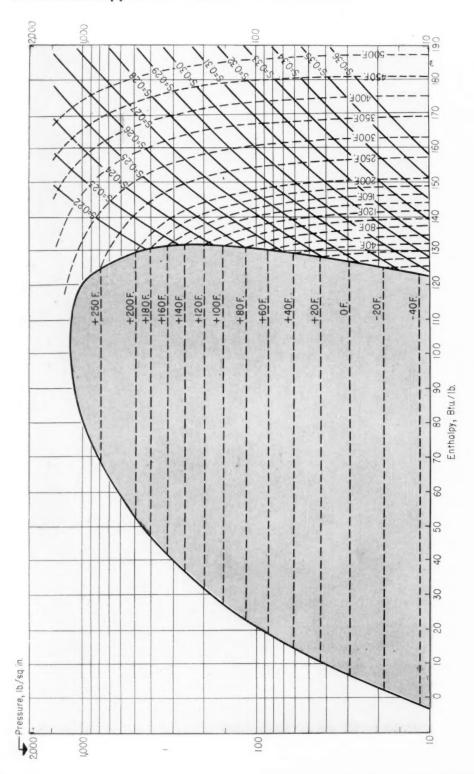
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#### Pressure-Enthalpy Data in Usable Form for HCl

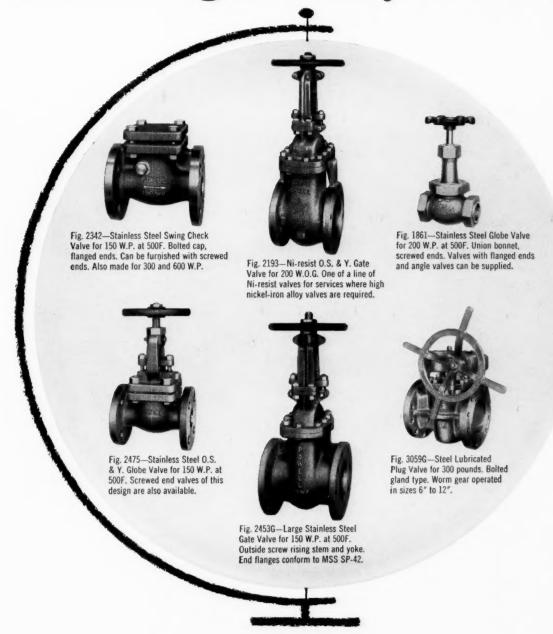


### Pressure-Enthalpy Data in Usable Form for Chlorine



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### PLANT NOTEBOOK EDITED BY T. R. OLIVE

### Sampler for Particles in Wet Gas Streams

Use a "diffusion tube" to dry the stream if moisture would otherwise condense in sampling line and filter.

\*November Contest Winner by Jess W. Thomas

Research Engineer, Whirlpool Corp., St. Joseph, Mich.

Filter-paper sampling of hot gaseous process streams to determine their content of solid particles can run into difficulties if the water vapor concentration is high enough to condense out in the sampling line and on the

sampling filter.

Of course, "hot sampling" will prevent condensation-that is, placing the filter paper holder directly in the hot process line, or heating the sampling line and filter holder. However, this has serious disadvantages. The collected particles may burn up on the hot filter. Furthermore, many filter papers, such as the especially efficient Millipore type (Millipore Filter Co., Watertown 72. Mass.), cannot be used at high temperatures.

Drying the gas by contact with an adsorbent such as silica gel would seem to be an obvious solution. However, you cannot pass the sampled gas through silica gel granules since particles would be lost by impaction. We were able to sample conveniently at room temperature without condensation or particle loss by using a device we call a "diffusion tube," shown in the sketch at the

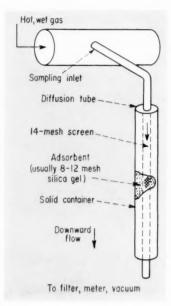
right.

Briefly, the diffusion tube consists of a jacket containing adsorbent which surrounds a pervious section of the sampling tube wall. It makes use of the enormous difference in diffusion rate between the particles and the water vapor molecules. A particle of 0.1 micron diameter -often the smallest size of interest-has a diffusion constant of about 10<sup>-5</sup> sq. cm./sec. Water vapor, on the other hand, has a constant of about 0.2 sq. cm./sec. Therefore, as the gas-particle

mixture travels down the tube, the water molecules readily diffuse through the pervious walla 14-mesh wire screen-and are adsorbed and removed. The particles, having a negligible diffusion rate, travel unhindered to the sampler.

Various writers (Townsend, Trans. Roy. Soc., 1900; Gormley and Kennedy, Proc. Roy. Irish Acad., 1949; Thomas, J. Colloid Sci., 10, 246, 1955) have considered the question of the length of diffusion tube required. This is theoretically dependent only on the flow rate used. The resulting equation was developed for ideal conditions of streamline flow through a smooth, cylindrical passage formed of perfect adsorbent, with only a small proportion of adsorbable material present. In our application, the wire screen surface is rough and the amount of adsorbable material may be considerable. Therefore, we found it desirable to add 50% to the tube length as calculated by the equation:

 $F = 0.82e^{-a} + 0.01e^{-6.1a} + \cdots$ where  $a = 3.66\pi DZ/Q$ 



Here F is the fraction of water vapor getting through the tube: D is the diffusion constant of the water vapor, in sq. cm./sec. at average tube temperature; Z is length of tube, in cm.; and Q is the flow rate through the tube, in. cc./sec.

For example, if we know that the water vapor in the wet gas

#### Did You Miss Last Issue's Announcement?

Starting with the April 7 issue, a new department to be called the Design Notebook will alternate with the Plant Notebook. This department solicits short articles primarily of interest to engineers in engineering research and development, and in process, plant and equipment design.

All articles submitted for either the Design Notebook or

the Plant Notebook will be considered at the end of each fourweek period for a single \$50 prize. In any such period a winner will be selected from either the Design or the Plant area and will be published in the appropriate department.

Articles received during February 1958 and later will be judged for both departments. For contest rules see p. 152.

### Now . . . a New High in Dust Filter Efficiency . . .



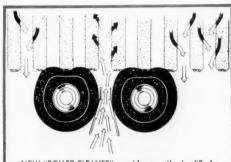
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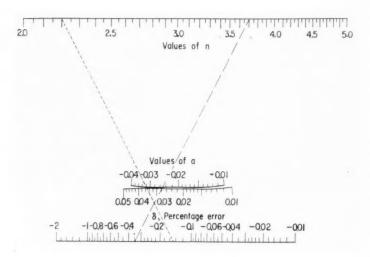
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line corresponds to 300% of saturation at the sampling filter temperature, then we set F at 0.33, substitute known values of D and Q into the equation, and calculate Z. We take the actual length as 1.5 Z. The value of F is independent of the diameter of the screen retainer for any value of Q, so diameter may be set for isokinetic sampling.

In sampling for particles in

gases from a combustion operation we used a diffusion tube 4 ft. long, with 0.5 in. inside diameter of the wire screen. The annular adsorbent space contained about 1 lb. of silica gel. With a flow rate of 0.012 cfm. of gas which was considerably above saturation at the filter temperature, we were unable to detect any water in the effluent, even after many hours of use.



### Reliability of a Simple Approximation

D. S. Davis

Head, Dept. of Pulp & Paper Technology, University of Alabama, Tuscaloosa, Ala.

The expression  $(1+a)^n$  often comes up in engineering practice. It can be approximated by (1+na) when a is small. We would doubtless use the approximation still more frequently if we had a ready means of determining its degree of reliability for any particular set of data.

The accompanying line coordinate chart is such a means. It enables one to determine quickly and accurately what the percentage error (always negative) will be for generous ranges of a and n.

The percentage error  $\delta$  inherent in this approximation is

$$100 \frac{1 + na - (1 + a)^n}{(1 + a)^n}$$

Recent work shows that when a is between 0.01 and 0.05 and n varies from 2 to 5, then  $\delta=c$   $(n-0.7)^d$ ; and when a is between -0.01 and -0.04 and n varies from 2 to 5,  $\delta=f$   $(n-0.7)^n$ . Here c,d,f and g depend on a. The equations are the basis for the chart.

As an example, how good an approximation for (1+a)" is 1+na when a=0.028 and n=3.70? The broken index line, which connects n=3.70 and a=0.028, intersects the  $\delta$ -scale at the desired value of -0.35%. When n=2.20 and a=-0.032 the dotted line shows the approximation is good to -0.15%.

#### Eliminating Air Bubbles In Measuring Density

S. N. Srivastava

Physics Dept., University of Allahabad, Allahabad, India.

Density is a commonly used criterion for judging the purity or concentration of substances in industry. The hydrometer is often used with liquids. Density of solids is found by loss of weight during submergence, the so-called flotation method. Flotation is often used to separate mechanical mixtures of solids of different densities. Such density measurements can be accurate to 0.02%.

The main source of error in various methods for determining the volume of a solid by submergence in water comes from adhering air bubbles. This trouble can be averted even with powders by using carbon tetrachloride, pure benzene or mineral oils instead of water.8 Or, in using water, it is possible to remove the air bubbles by shaking and placing in a vacuum desiccator.4 And, in a special pycnometer designed by Andreae,6 the air spaces in crystals are avoided by depositing the crystals from solution in the apparatus itself.

I have used the following simple scheme very successfully to remove air. First the water to be used for submergence is freed from air by boiling. Then the solid is submerged in the water and the flask filled to the top and corked.

Many air bubbles will be introduced with the solid but since the water is unsaturated with respect to air, the adhering air will be quickly dissolved.

Now it is possible to go ahead and determine the density by either the flotation method, the specific gravity bottle, the Nicholson hydrometer or by other common and usual methods.

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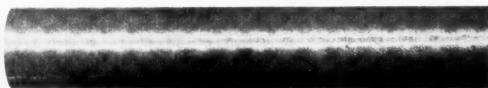


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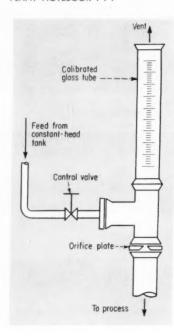
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#### Simple Flowmeter Handles Small Liquid Flows

R. G. Bierbower

Plant Engineer, Delaware Works, General Chemical Division, Allied Chemical & Dye Corp., Marcus Hook, Pa.

Sketched above is a simple homemade flowmeter which we have found useful in controlling small flows of liquids to a process. The meter is particularly useful where corrosive liquids must be handled, or where a high degree of accuracy in controlling the flow is required. It is simple, inexpensive, and can easily be put together in your own shop.

The idea is merely to provide a transparent standpipe, open at the top to the atmosphere, above a calibrated orifice. The head in the standpipe will then determine and measure the flow through the orifice. A typical meter built to handle sulfuric acid was made up as follows.

1. A standard 1½-in. Pyrex glass tee.

2. A 12-in. length of 1½-in. Pyrex glass pipe, etched for 10 in. with a scale graduated in millimeters.

3. A stainless steel orifice plate with a \(\frac{2}{3}\)-in, sharp-edge orifice.

4. Teflon gaskets of the en-

5. A ½-in. stainless steel barstock needle valve with stainless steel nipple and flange for connecting to glass.

These parts were assembled as in the sketch. If needed for highly corrosive or C.P. grade liquids, the orifice plate can be made of glass and a porcelain valve used.

Feed to the meter should be from a constant-head tank to avoid feed rate variations. The top of the calibrated standpipe must, of course, be vented to the air, or to a vent system if noxious or corrosive fumes are involved.

For accurate measurements the meter should be calibrated with the liquid to be metered and a curve plotted of flow rate vs. scale reading. The approximate calibration can be calculated from the relationship:

 $Q = 19.636Kd^2 \sqrt{h}$ 

where Q is flow rate, gpm.; d is orifice diameter, inches; h is the head above the orifice, ft. of the liquid; and K is the discharge coefficient, 0.61 approx.

This expression applies when the ratio of orifice to pipe diameter is less than 0.3 and when the discharge is at atmospheric pressure. For other diameter ratios and discharge pressures, consult texts on orifices.

The meter described has a minimum head of 51 in. or 0.437 ft. and a minimum capacity of about 1.1 gpm. Its maximum head is

154 in. or 1.27 ft., and maximum capacity, about 1.9 gpm. With proper calibration accuracies of 0.5% or better can be obtained.

One word of caution: Liquids containing dissolved gases may release bubbles in the control valve or the orifice which will cause vapor binding and lead to erratic flow.

#### Convenient Flow Formula For Water in Pipes

D. M. Lindamood

Hercules Powder Co., Radford Arsenal, Radford, Va.

The extensive series of flow formulas published in *CE* during the past year prompts me to add still another one which I have found to be exceptionally convenient for flow of water in clean steel pipes at 60 F.

This formula is

$$\Delta P = \frac{Q^2}{28.1D^5}$$

where  $\Delta P$  is the pressure drop per 100 lin. ft. of pipe, psi., Qis the flow rate, gpm., and D is the inside diameter of the pipe, inches.

This empirical equation gives results that compare favorably with the Williams and Hazen formula and with the rational Fanning equation. The form of the equation is similar to that of the Saph and Shoder formula, although it is simpler (no fractional exponents) and is slightly more accurate.

#### NEXT ISSUE: Watch for January Winner Announcement

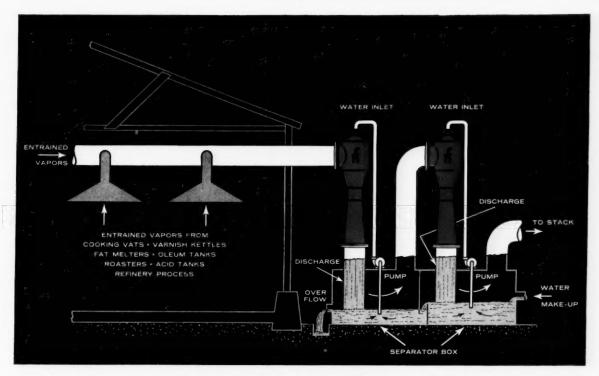
#### ★ How Readers Can Win

\$50 Prize for a Good Idea—Until further notice the Editors of Chemical Engineering will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize. How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates (\$10 minimum).

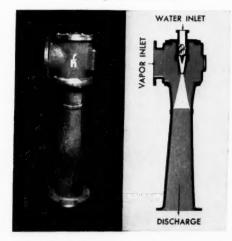
Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.



#### **CONTROL OBJECTIONABLE FUMES, GASES, VAPORS**

### with an economical SK Fume Scrubber

Photo and sectional drawing of an SK Fig. 4010 Fume Scrubber



JET APPARATUS: Ask for Condensed Bulletin J-1.

ROTAMETERS & FLOW (NOICATORS: Ask for Condensed Bulletin 18-RA,
VAVES: Ask for Condensed Bulletin V-T.

HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-T.

FERR PUNNES: Ask for Bulletin 17-A.

A food plant in California uses an SK Fume Scrubber to condense steam and scrub oil vapors from cooking vats. A large chemical manufacturing plant on the eastern seaboard uses a battery of SK Fume Scrubbers to condense steam and purge entrained gas containing  $H_2SO_4$ ,  $SO_2$ ,  $H_2S$ ,  $TiO_2$ , and ore dust. A mid-western manufacturer uses SK Fume Scrubbers to vent oleum tanks. A soap maker in Pennsylvania uses a scrubber to remove ammonia fumes from a plant building and cool the building at the same time.

From coast to coast, chemical and food processing plants, refineries, paint and varnish manufacturers, fertilizer, and other manufacturing plants are using SK Fume Scrubbers to control objectionable—sometimes dangerous—fumes, gases, vapors, and dusts.

These manufacturers have found that SK Fume Scrubbers are reasonably low in initial cost, require little maintenance, and are an effective means for conforming to local ordinances which prohibit the pollution of air.

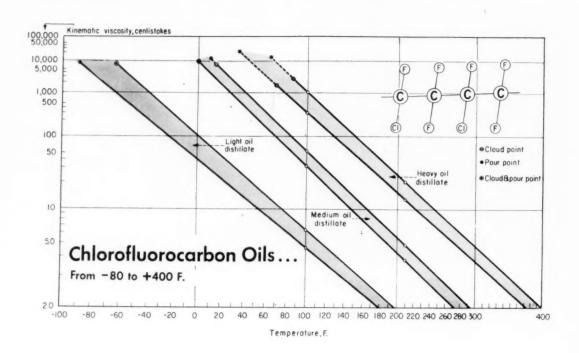
Made in a wide range of sizes from cast iron, steel plate, Haveg, stoneware, or other materials or with linings of rubber or Polyvinyl Chloride, or other synthetic materials, SK Fume Scrubbers can help you solve a fume or dust problem. Why not get the whole story. Send for Bulletin 4R which contains complete information on SK Fume Scrubbers.

# Schutte and Koerting

MANUFACTURING ENGINEERS SINCE 1876 2217 State Road, Cornwells Heights, Bucks County, Pa.

#### PRACTICE ...

## CORROSION FORUM EDITED BY R. B. NORDEN



### **Lubricate Under Corrosive Conditions**

Chemically inert as their high molecular weight cousins, chlorotrifluoroethylene oils are fast coming into use where lubricants must contact corrosive materials.

Fluorinated oils, greases and waxes—chemically inert, thermally stable—long hidden under the blanket of atomic security, are making important inroads in the chemical process industries.

They are proving ideal as lubricants in contact with corrosive, hazardous chemicals.

The high molecular weight resin polymer of chlorotrifluoroethylene is well known as Kel-F or Fluorothene. The lower molecular weight polymers have physical properties ranging from low-viscosity through high-viscosity oils (see curves above) to greases and waxes. Three companies are active in the production of low molecular weight fluoropolymers: Minnesota Mining and Manufacturing, Jersey City, N. J.; Hooker Electrochemical, Niagara Falls, N. Y.; and Halocarbon Products, Hackensack, N. J.

Polymers are built up from monomers by controlled polymerization, then vacuum distilled to separate out various oil and wax fractions. Viscosity, through molecular size and weight distribution, is controlled by this distillation step to give a wide variety of lubricants.

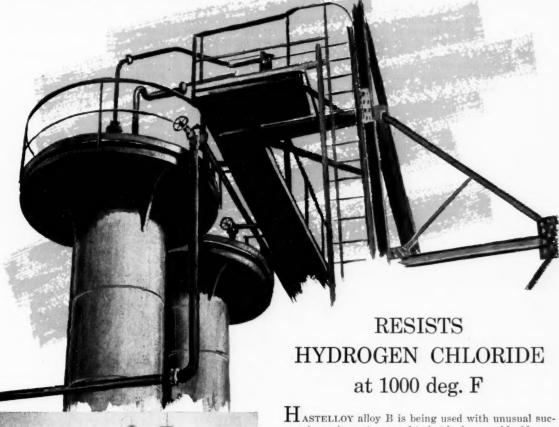
► Resistant to Corrosives—Oils, greases and waxes have proved

resistant to compressed oxygen, mixed inorganic acids, caustic solutions, halofluoride gases, oleum, red fuming nitric and 90% hydrogen peroxide. One of the big applications for the lubricants is in compressors handling these hazardous chemicals.

There are three materials which attack fluoropolymer lubricants: molten sodium reacts with the polymer; liquid fluorine and liquid chlorine trifluoride react explosively with any organic molecule. You can use the lubricants with gaseous fluorine and chlorine trifluoride.

► Better than Silicones — Silicone oils, usually considered for difficult lubrication problems, are not nearly as resistant to oxidizing agents as fluoropoly, mers. The carbon-hydrogen and silicone-oxygen bonds are at-

HAYNES Alloys solve the tough corrosion problems



Hastelloy alloy B is being used with unusual success in equipment exposed to hot hydrogen chloride gas containing water. In one installation, where the highly reactive gas is at 1000 deg. F., alloy B has outlasted previously used materials by 30 to 40 times! Here, tower covers, piping, and valves made of alloy B are located on top of chlorine burners in a tetraethyl lead plant. They were in service for 6 years before requiring maintenance.

Hydrogen chloride gas is only one of thousands of corrosives that are successfully handled by HASTELLOY alloys. These nickel-base materials have unusual resistance to the hot mineral acids, strongly oxidizing salts, and powerful gaseous oxidants. For complete information, send for the newly published booklet describing these alloys. Write to Haynes Stellite Company, Distribution Section, 30-20 Thomson Avenue, Long Island City, N. Y.



HAYNES STELLITE COMPANY

Division of Union Carbide Corporation Kokomo, Indiana



Concentrated Sulphuric Acid flows across perforated trays made of HASTELLOY alloy B in these drying towers. Alloy B resists the corrosive effect of the acid and helps maintain the efficiency of the tower. The trays have been in use since 1949.

"Haynes," "Hastelloy" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

tacked by strong acids and alkalis. Silicones are also subject to slow air oxidation at elevated temperatures, although additives can prevent this.

However, silicones have one big advantage over fluorolubricants: an excellent viscosity index (remains liquid at low temperatures). High-temperature fluoropolymers are waxes at room temperatures, and their use is restricted to applications where you can preheat equipment.

What About Solubility?—While the fluoropolymers are all insoluble in water, glycols and hydrophylic materials, they are definitely soluble in aromatic, aliphatic and chlorinated hydrocarbons, esters, ketones and similar compounds.

Generally, there's a decrease in solubility as the fluoropolymer molecular weight increases (waxes are much less soluble than the oils). A deterrent to a number of applications, these solubilities must be taken into account before considering the oils and greases as sealing materials or lubricants.

The oils are also soluble in chlorotrifluoroethylene plastics, acting as plasticizers. There is some solubility in butadiene/styrene rubbers, natural rubber, silicone rubbers, isobutylene/isoprene rubbers and polyethylene. The oils have no effect on polyvinyl alcohol based elastomers, butadiene/acrylonitrile, Hycar, Neoprene GN or Teflon.

As far as corrosion effects, fluoropolymer oils can be considered as noncorrosive to metals up to about 350 F. The one exception is copper which will discolor at temperatures over 120 F.

► Wide Temperature Range— Usually manufacturers recommend that the oils, greases and waxes be used below 500 F. with the maximum short-term temperature at 550 F.

At 620 F. decomposition to toxic gases occurs rapidly. At 580 F. this decomposition takes place more slowly but it's still very noticeable.

► Two Greases Available—Lubricating greases are of two types. One consists of a fluoropolymer oil thickened by introducing very finely dispersed silica. This prevents use of the grease in contact with alkalis.

The second type (made by Halocarbon) contains no inorganic. Grease consistency is achieved and controlled by degree of polymerization and by blending oils and waxes. It can be used over the entire pH range.

Fluoropolymer waxes are now under development for special applications such as stuffing in packings, sealant components, and in blends with greases as anti-adhesion and anti-galling agents.

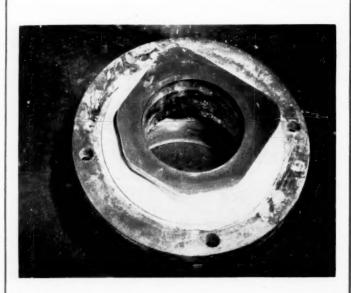
Braided Teflon and asbestos packings have been impregnated with fluoropolymer oils and greases for corrosive service, reducing shaft wear and giving good seals at the shaft interface.

► Cost No Deterrent—Costwise these materials are in the \$10 to \$20/lb. range. This is high cost on a per unit basis, but actual performance cost over a period of years should be low.

In a recent application one drum of fluorolubricant was specified for a compressor handling a highly hazardous gas. Initial lubricant cost was about \$2,000, but annual make-up will run to about \$20.

New Applications Coming— Looking to growing markets, the producers also stress the high electrical resistivity and dielectric strength of the lubricants and look to applications outside the lubrication field:

1. Fire and explosion-proof hydraulic fluids.



#### Hard Carbide Inserts Lick Valve Erosion

Ever since the introduction of fluid cracking units in the petroleum industry, slide valves controlling the flow of catalyst have been one of the weakest operational points in the process. Catalyst flows through the valve eroding away metal until the valve fails.

Atlantic Refining engineers

appear to have finally come up with a solution. They have developed a method of fastening tungsten carbide inserts (G. E. Carboloy) to form a lining by using dove-tail locks. Brazing is not used. Cost of facing and lining an 8-in. valve runs to \$2,019, but so far the lined valves are holding up very well.

# DEPENDABLE!

## is the word for DURCO INSTALLATIONS





Durcopumps on tank car loading of residual tar at 200° F. These pumps handle approximately 150,000 gals, a day. Durcopumps exclusively are also used by J & L for tar distillation units with temperatures up to 600° F.



Durco Type J202 Durimet 20 Y valves handling 60° Be. sulfuric acid mixed with coke oven light oils, and neutralized by sodium hydroxide. These Durco valves replaced 316 stainless steel gate valves that leaked after six months' service. The Type J valves have now been in service for more than 1½ years with no sign of corrosion or line leakage. The atmosphere in this area is also severely corrosive.



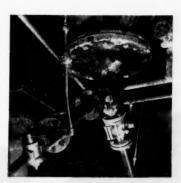
One of the first Durco Type F valves ever built. This valve has been in continuous service since December 31, 1949, handling 5% sulfuric acid saturated with ammonium sulfate.



Durco Type J202 Durimet 20 Y valve in service on inlet of 20,000 gals. 66° Baume H<sub>2</sub>SO<sub>4</sub> storage tank. This valve replaced a 316 stainless steel gate valve.

DURCO DEPENDABILITY is the reason for these and many other DURCOPUMP and DURCO VALVE installations at the Jones & Laughlin Steel Corporation's By-Product Plant in Pittsburgh.

DURCO handles the *tough* corrosives and the *tough* services throughout the chemical process industries. The fact that DURCO equipment can be depended upon for maximum service life with minimum maintenance is the basic reason more people every day are turning to DURCO chemical process equipment. For complete details, call or write: The Duriron Company, Inc., Dayton, Ohio, or contact your nearest Durco Sales Office.



Durco Type F valves on lines from constant feed storage tank to centrifugal dryers. The tank contains 5% sulfuric acid saturated with 15-20% ammonium sulfate crystals in suspension.



Series R Durcopump with more than five years' service, and Durco Type F valve with more than three years' service handling Ammonium Sulfate solution at 105° C. "Absolute minimum of maintenance."



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- 2. Damping fluids for gyroscopes.
  - 3. Heat transfer medium.
- 4. Electrical applications, including liquid dielectrics.
- Plasticizers for fluoroplastics.
- Diffusion pump media, using the low molecular weight oils which have high vapor pressures at high temperatures.

#### Titanium Comes From New Plant

Billets, rounds and sheets now come from the first facility devoted exclusively to rolling and forging of titanium—Titanium Metals Corp.'s plant at Toronto, Ohio.

Jointly owned by National Lead and Allegheny Ludlum, the new plant has integrated facilities for milling sponge into finished forms.

TMC installed equipment specially designed or modified solely for titanium production. They hope to reduce metal loss—a big cost problem—and to improve quality of titanium with the new equipment.

#### Beryllium, Next Wonder Metal?

Light, strong, heat-resistant beryllium is rapidly becoming a full member of the growing family of wonder metals.

As a moderator for slowing down neutrons, and as a reflector for containing neutrons, beryllium has a big market in atomics. But as a sign of what's coming, the Air Materiel Command at Wright-Patterson Air Force Base has awarded a contract to Brush Beryllium for development of methods for making large sheets of beryllium. This should spur nonatomic applications.

Beryllium is three times stronger than steel on a strength-to-weight ratio, weighs two-thirds as much as aluminum, and maintains its strength at 1,000-1,200 F. Some beryllium base alloys can stand up to temperatures of 1,500 F.

Fabricated forms of beryllium are available (sheet, rod, plate, tube) but in relatively

small sizes. The development contract calls for rolling sheet beryllium, from pressed powder slabs, up to 30-in. wide.

Brush Beryllium makes the smaller size forms by powder metallurgy techniques. Raw metal is produced as pebbles or beads by reduction of beryllium fluoride with magnesium. These are vacuum melted and cast into ingots which are ground to powder. A variety of shapes are produced by low pressure (100-200 psi.), hot pressing under vacuum.

The basic fabrication process has been augmented by other powder metallurgy techniques —cold pressing, hot pressing at high pressure, hot molding with extrusion, forging and rolling.

#### Metal Bellows Made From Inconel

Inconel metal bellows are now available from the Fulton Sylphon Div. of Robertshaw-Fulton Controls Co. Designed for corrosive conditions of high temperatures and pressures, the bellows come in outside diameters from ½ to 12-in. and in single to four plies.

Tests on the bellows (Inconel and Inconel-X) indicate a 2-in. outside diameter, four-ply bellow is capable of withstanding 1,000 psi. at room temperature.

Inconel-X bellows—an age hardening metal—have very stable hysteresis factors. They are finding wide application in instruments where precise response must be repeated many times over an extended period.

#### Plywood Ducts Resist Corrosives

One of the toughest problems, from a corrosion standpoint, in chemical plants involves selecting materials of construction for exhaust systems. All sorts of chemical mixtures have to be handled and you'll find a wide variety of metals and nonmetals in use. One interesting new application has recently come to our attention: plywood exhaust ducts.

Installation is in a plant producing cellophane. The system

removes warm ventilating air containing low concentrations of sulphuric acid, hydrogen sulfide, carbon bisulfide, water vapors, as well as sulphate salts. Inside duct temperatures vary from 30 to 60 C.

Material for the ducts is high-density fir plywood, with an epoxy-resin-impregnated fiber permanently bonded to the surface under pressure and temperature. Plywood is ½-in. thick with overlay on both sides. Sections are fabricated with lap-joint reinforcing. All interior and exterior joints and all raw wood surfaces are coated with epoxy glue.

Each duct consists of a 150-ft. long manifold, tapering to a 4-ft. square opening at each end. It ties into several pieces of equipment inside the plant, with vertical plywood ducts passing through the building

#### New Tin-Lined Copper Tubing

A new process for lining copper tubing with a protective layer of tin has just been announced by the Myron L. Co., Monterey Park, Calif.

An impervious tin lining is placed inside copper tubing. Heat treatment produces a strong bond between Cu and Sn.

The manufacturer claims tubing can be cut, bent, flattened, soldered or heated to 300 F. without destroying the bond. When flaring the tubing, tin acts as a lubricant and as a sealing material for the finished connection.

#### Big Meeting in San Francisco

The 14th annual conference and exhibit of the National Association of Corrosion Engineers is scheduled for Mar. 17-21, 1958, at the Civic Auditorium in San Francisco.

Among the sessions will be: protective coatings; another on corrosion fundamentals; one on cathodic protection; plastics; elevated temperature corrosion; and corrosion problems in the chemical industry.

# HIGHEST ABRASION RESISTANCE-HIGHEST CHEMICAL RESISTANCE

ever built into a fire hose



Flexible! Easy to ra

This is the most rugged hose ever built for the refining and petro-chemical fields.

Yet it is the lightest and most flexible of all covered fire hose! Ask the fire crews who

A fast-running, husky fire crew can pull it over jagged concrete, around sharp pillars—without any damage to it. Kinking or being run over does no harm. Even rats and termites can't chew it (believe it or not, over 600 feet of ordinary fire hose were eaten up last year in just one Texas plant). U. S. Matchless® has a special cord ply carcass made of "Ustex" fabric, resistant to rot and mildew. The white (or black) oilproof neoprene cover resists oils, acids, fumes and strong, hot sunlight.

Other hose made by United states Rubber Company for the refining and petro-chemical fields include:

- Flexlite, the all-Dacron\* Single Jacket (weighs 48 lbs. per 100 ft.) (withstands 500 lbs. test pressure)
- "Reliance®" Double Jacket Dacron reinforced (weighs 50 lbs. per 100 ft.) (withstands 400 lbs. test pressure)
- "Reliance" Double Jacket Dacron reinforced (weighs 54 lbs. per 100 ft.) (withstands 600 lbs. test pressure)

Obtainable at any of our 28 District Sales Offices, at selected distributors, or write us at Rockefeller Center, New York 20, N. Y.

\*DuPont's trademark for its polyester fiber.



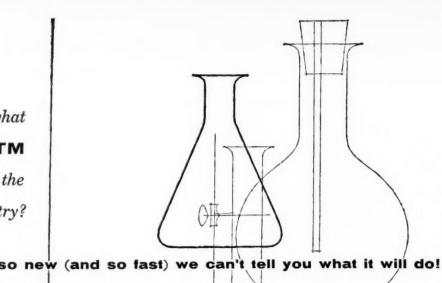
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**United States Rubber** 

CHEMICAL ENGINEERING—February 10, 1958

159

what
will the STTM
do for the
chemical industry?



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# Chemical Engineering

# People

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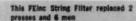
When your filter runs hour after hour...month after month...
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#### FILTRATION ENGINEERS

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# Roundup on a Trilogy of Controversy

### L. Court Says "No!" to Moving Tax

Internal Revenue Service now plans to appeal a New Mexico federal district court ruling that has freed engineers, scientists and other employees from taxation on payments made to them for their moving expenses. The court decision applies to payments made by hiring firms to new employees.

Before this decision, IRS had ruled that payments to new employees were taxable income. U. S. District Judge Carl A. Hatch's court in Albuquerque handed down the precedent-setting decision and gave IRS an October deadline for filing appeals. Appeal arguments are scheduled to be heard in the Tenth Circuit Court of Appeals in Denver, probably towards the end of this month.

Two test cases were selected from among 300 new technical hires at the Sandia Corp., a prime contractor for the Atomic Energy Comm. in Albuquerque. One case was filed in behalf of a new graduate from the Univ. of Kentucky; and the second was in behalf of an experienced engineer hired by Sandia.

In both cases, Judge Hatch

granted full recovery of all income taxes and interest penalties paid to IRS for the reimbursed moving and travel expenses—and for the entire family.

Attorneys told CE's correspondent in Albuquerque that the decisions affect only the moving expenses paid to "new hires." It is already well established—both by IRS and by court decisions—that where an employee working in one city for a company is later transferred to another city by the same employer, his travel and moving expenses are tax-deduc-

### 2. What Salary Should You Expect to Receive?

Sir:

What salary would you expect? This question is received with greater apprehension on the part of the engineering applicant than any other he is confronted with in the course of his employment interviews.

To set his figure too low implies a lack of confidence in his own ability. At best it may raise doubts in the minds of the interviewers as to his worth to their companies. On the other hand, setting the figure too high may close the door.

Technical work requires good judgment, and your salary is certainly worth careful consideration on your part.

This problem—while affecting all applicants—is especially difficult for the applicant with prior technical experience. Picture the quandary of the veteran of the armed services who has worked

for one or more years in radar and electronics, valuable engineering experience; of the man who worked as a laboratory technician or control chemist for several years before completing his education; or of the nightschool graduate who may have been doing actual engineering work for several years.

Is this background experience worth a premium in the open market? If so, how much?

Most engineering graduates know or can find the average starting pay scale for their profession. Chemical Engineering and most other major engineering publications usually list these figures several times each year. The technical graduate can then assess his scholastic record and his degree of participation in other school activities and arrive at a realistic figure in compari-

son with his fellow applicants.

The recruiter from industry will know that most students have several interviews and will try to make his offer as attractive as possible to sign up the applicants who might benefit his company. The element of competition among employers for the better students has resulted in pay scales that please the recent graduate.

But what about the nightschool graduate with industrial, sales or supervisory experience? The military electronics specialist and the experienced graduate? How should any one of these men answer that all-important question?

Admittedly, this experience is valuable, but how can this person reach a realistic figure—a figure that is also fair to himself?

Perhaps the first step is to see

the problem from the employer's viewpoint? Can he use your background directly or indirectly? In what category and in what quantity does your experience fall? The technical sales applicant who has had prior sales experience will find a direct connection. Product and technique may be different, but methods of dealing with people are essentially the same.

The research-minded young man who has worked in a chemical laboratory has a valuable background in technique and work habits and generally knows what is expected of him better than his classmates on their first

jobs. The night-school student with experience in production might find young engineering graduates starting on the same type of work that he has been doing for several years.

How much is this experience worth in starting salary scales? Be critical and honest when answering the all-important question. The procedure, outlined below, for finding your value to industry has worked well for this writer and for a number of my engineering colleagues:

 Estimate the probable salary you would receive if you had no prior experience or training other than your major degree. • Total the years of applicable background you can offer for the position you are seeking.

 Add about \$25 to \$35 per month for each year of this applicable experience.

You should now have a realistic estimate of your approximate worth to industry. The trick is to determine what is applicable experience. Remember that three years experience on a particular job might mean three years of experience. On the other hand, it might mean one year's experience gained three times.

HAROLD BARTZ Plainfield, N. J.

### 3. About the Supply of Engineers, More or Less

Sir:

In nearly every technical magazine today, we read articles based on the current shortage of engineers and scientists in chemical industry throughout the nation. The question raised is always, "Why is there such a shortage?"

Is it due to an insufficient number of students interested in the field of engineering? Is it because the college courses are too hard and thereby cause students to change their courses in midstream to another field that does not tax them too much? Or is it because many of the students (I should say potential engineering students) do not have an opportunity to attend college because of money?

At this point, someone would say, "Well, there is federal aid to students who want to attend colleges." Federal grants are not the answer to the problem. I believe that one answer to the problem of attracting potential scientific and engineering students into colleges is for the states to set up personnel bureaus in high schools. These bureaus would screen students in their senior year and determine whether they are capable of becoming scientists and engineers. If they are, states would provide private personnel guidance to encourage

them to enter the fields that the counselors believe they are suited for

Once having encouraged the initial trend of thought, and if the students are in need of financial assistance, they can be directed to one of the state universities that are accredited in engineering but are not too costly to attend. Next step would be for the schools to furnish scholarships similar to those given athletes.

Each state would have a limited amount of scholarships of this type, but think of the possibilities of increasing the number and quality of engineering students. It may be that a period of 20 years would be required for the state to regain the moneys put out for an engineering or science graduate. However, the added income of a person who otherwise would be an office worker, tradesman or technician, and the states taxes on this increased income, would more than offset the initial investment.

Here's another suggestion:

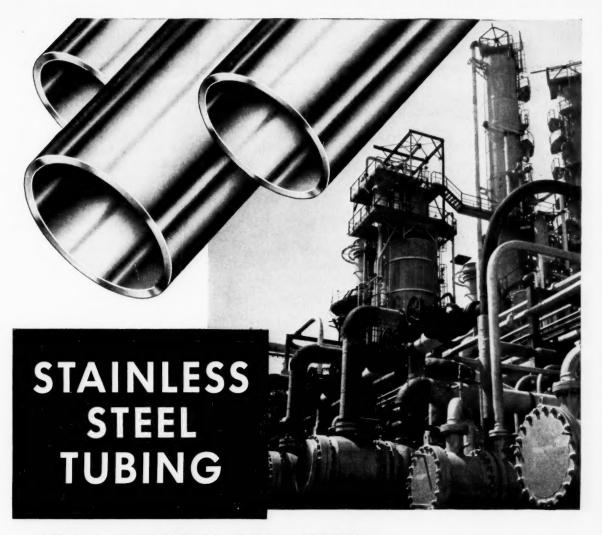
All too often we read of and hear about the high starting salaries being paid college graduates intended to encourage John Public, Jr. to become a scientist or an engineer. One way for industry to spread the good word around is to increase proportion-

ately the salaries of men already on the payroll. Too often the salaries of men with five years or more experience remain static, so that many of these men begin to talk about the profession as not being lucrative enough. With this talk they discourage potential entrants to the profession.

The best advertisement is still passed on by people interested in and proud of the profession they are part of. I heartily encourage any and all young people with whom I come in contact to enter into the engineering profession, especially chemical. I feel that chemical engineering has more potential than any of the other branches of engineering and it can be as interesting as the individual wants.

My own salary is not too high; but I feel that it compensates me for the experience that I have and for the work that I do. Don't misunderstand me. It's not as high as I would like it to be and that's why I study and try to keep up with changing technology. I believe that all young people who are interested in engineering should be ambitious with a deep initiative to do as capable a job as they can.

FRANK KIEFER, JR. Process Engineer Walter Kidde Engineers, S. W. Houston



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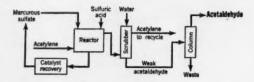




STAINLESS STEEL TUBING AND PIPE

# TECHNICAL BOOKSHELF

#### From Acetylene



#### Reaction

CH=CH + 
$$H_2O \xrightarrow{H_{22}SO_4, H_2SO_4} CH_3CHO$$

95% yield

25% conversion per pass

#### Material and Energy Requirements

Basis-1 ton acetaldehyde

Acetylene Catalysts (sulfuric acid and mercurous sulfate) Electricity Steam 1,240 lb Small 120 kw-hr 7,500 lb

SAMPLE illustration gives part of the broad picture of acetaldehyde.

#### The Broad Picture-Fast

INDUSTRIAL CHEMICALS, 2nd ed. By W. L. Faith, Donald B. Keyes and Ronald L. Clark. John Wiley & Sons, New York. 844 pages. \$16.

Here the Faith-Keyes-Clark trio takes a sweeping, bird's-eye view of 140 industrial chemicals and 241 processes for making them. For 844 pages, that's an average of six pages per chemical.

Let's take a look at the first chapter — acetaldehyde — since it's typical of all 140 chapters. What does this 7-page section contain?

► Three Processes—First is a terse, factual resume of the three commercial methods of making acetaldehyde: from acetylene, from alcohol by vapor-phase oxidation or dehydrogenation, from butane by vapor-phase oxidation.

Each of these three methods has skeletal facts on the flow-sheet, reaction and material-energy requirements. Typical of all processes in the book is the visual format shown above.

After this is a typical halfpage description of process highspots—temperatures, pressures, catalyst, yield, operating conditions.

▶ Production and Use—Output figures for 1935-1955 are shown in a simple graph, use pattern for 1954 in a typical table:

Acetic	aciu	and ar	my-	
dride				60 %
Butano	1			28
2-Ethyl	he	xanol	and	
other	aldo	l produ	cts.	7
Pentaer	rythr	itol		3.5
Miscella	aneou	IS		1.5

100.0

Price trends for acetaldehyde (as for each chemical) are shown for 1936-1956 as a simple graph.

Misc., Etc.—Condensed information is given—typically in two or three short paragraphs—on properties, grades, containers and regulations.

► Economic Aspects—Here the authors point out, in broad sweeps and within a page of text, significant economic aspects. Typical: trends among competitive processes and raw materials, economic plant size and cost,



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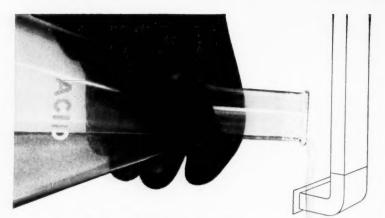
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shifts in use patterns, effect of co-products, capacity range of commercial plants, plant cost per annual unit of capacity.

Finally, manufacturers and their plant sites are listed (probably as of mid-1956).

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If you often need to get the broad picture—and to get it fast—this is your handy reference.—JRC

#### A Many-levelled Appeal

pages.

POLYTHENE — THE TECHNOLOGY AND USES OF ETHYLENE POLYMERS. Edited by A. Renfrew and Phillip Morgan. Iliffe & Sons, Ltd., London; Interscience Publishers, New York, 567 pages. \$18.50.

Reviewed by Ralph M. Knight.

Polythene is not a brand name but the generic term used in the United Kingdom for what in the U.S. and elsewhere is called polyethylene. "Polythene—The Technology and Uses of Ethylene Polymers" presents, as of early 1957, all relevant information on the various chemical and technological aspects of this prominent plastic material. The book consists of 32 chapters written by experts in their special fields.

The 32 chapters are presented in three parts, I. Manufacture and Properties, II. Processing Techniques, III. Applications and Prospects.

Part I deals mainly with the basic chemistry of polymerized ethylene, the compounding of polyethylene, its electrical, mechanical, and chemical properties, and the modifications of these properties through irradiation and chemical techniques. Part II presents the various

processing techniques. The most important of these—extrusion of film, cable covering, pipe, paper coating, etc.; injection molding; and bottle blowing—are thoroughly treated.

Also presented quite elaborately are techniques which in the U.S. consume relatively small volumes of polyethylene, such as centrifugal casting, spray coating, or dip coating, while others which are gaining prominence in the U.S. are omitted, e.g. vacuum forming and calendering.

Part III deals with the more significant fields of applications: dielectric insulation, films, piping, the chemical plant, household goods, textile yarns and fabrics. It is supplemented by two chapters on the outlook in the U.K. and the U.S.

Thirty-two chapters contributed by an equivalent number of authors or teams of authors are bound to overlap. Obviously, the editors have eliminated numerous duplications and replaced them by footnote references to other chapters (though, unfortunately, not to specific pages).

Where other such duplications have not been excluded, the reader will benefit from getting the same topic presented from various angles. Properties, thoroughly reviewed in Part I, are elaborately discussed again wherever they are essential in specific fields of applications such as film or electrical insulation. However, environmental stress cracking is dealt with in three different chapters, and here one cannot help having a feeling of repetitiousness.

The book as a whole is a wellplanned and authoritative compilation and critical analysis of all pertinent facts. It will appeal to many levels-the man in the shop, the chemical engineer, the technologist, even the market researcher. Many recent developments in the comparatively new field of high-density polyethylene are included. It is evidently not intended for specialized scientific workers who will find more theoretical knowledge compiled in its American counterpart, "Polyethylene", by R. A. V. Raff and J. B. Allison. It is interesting to learn that British plastics people find some of the standard tests employed in U.S.

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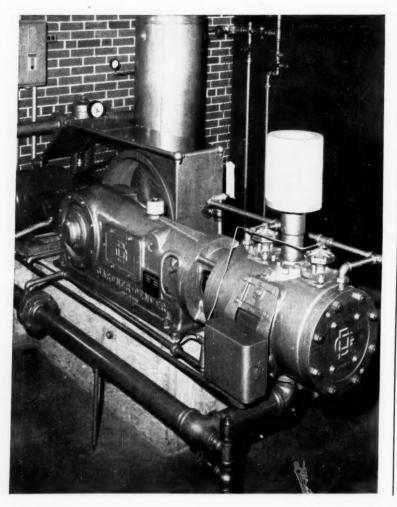
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BOOKSHELF . . .

laboratories and shops not acceptable.

In the light of a major topic of discussion these days, it is also interesting to note that the American author of "Future Outlook in the U.S.A." thinks in this context predominantly of the industrial utilization of existing processes, of markets, sales and production figures, while the author of "Future Outlook in the U.K." (who, by the way, is A. Renfrew, one of the editors and an I.C.I. director) visualizes the future of polyethylene rather in terms of research. He refers to many fields in which there "is still a great deal to be learned": reaction kinetics; effects of long and short chain branching; ever closer control of the molecular structure and, therewith, the polymer properties; techniques of copolymerization; new types of catalyst such as gamma rays; improvements in compounding techniques: increase in extruder screw speeds to several thousand rpm. (with which some manufacturers are now experimenting) with correspondingly increased output; a considerable increase in the extruder compression ratio; mixtures of polyethylene with asphalt for road surfacing or with natural and synthetic rubbers to reinforce the base material and make it useable for such applications as tires.

#### A Small Library

Volumetric Analysis, Vol. 3. (Titration Methods, Oxidation-Reduction Reactions.) By I. M. Kolthoff and R. Belcher, with V. A. Stenger and G. Matsuyama. Interscience Publishers, New York. 714 pages. \$15.

Reviewed by R. Browning.

This book is not of general interest. However, while it is not sufficiently critical for use as a laboratory manual, analytical chemists will find reference copies invaluable. The book is really a small library on the subject.

The format is similar to that of the other volumes. Following a very short section extending information in Volume 1, a number of reagents are discussed in turn; for each, a review of basic considerations is followed by sections describing applications to the determination of inorganic substances.

Iodine is the reagent most thoroughly discussed. Permanganate and bromate receive more attention than iodate, periodate, dichromate, hypohalite, and ceric salts, which share honors with a section on Karl Fischer reagent. A number of other reagents (mostly metals) are granted a few pages each. Ascorbic acid is the only organic substance to get more than mention.

#### BRIEFLY NOTED

COOL FLAMES—A KEY TO IGNITION AND COMBUSTION OF HYDROCARBONS. 13 pp. By Homer W. Carhart, Kingsley G. Williams and J. Enoch Johnson. Naval Research Laboratory report. Available on loan, to members, from National Petroleum Association, Munsey Bldg., Washington 4, D.C. Describes experimental results of studies on cool flames.

COMPILATION OF CHEMICAL COMPOSITIONS AND RUPTURE STRENGTHS OF SUPER-STRENGTH ALLOYS. 6 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 75c. Lists name, nominal chemical composition and characteristic rupture strengths (100 and 1,000 hr.) and patentee for about 150 domestic and 75 foreign alloys.

HANDBOOK OF POWERED INDUSTRIAL TRUCKS. 96 pp. Industrial Truck Association, Ninth and F Streets, Washington 4, D. C. \$5. Gives uses and engineering data of industrial trucks.

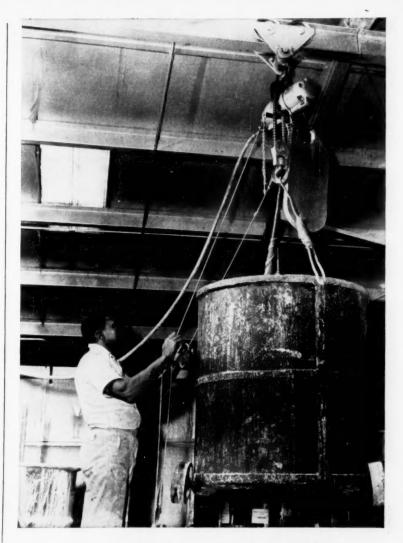
#### MORE NEW BOOKS

TRACER APPLICATIONS FOR THE STUDY OF ORGANIC REACTIONS. By John G. Burr, Jr. Interscience. \$7.50.

PROGRESS IN SEMICONDUCTORS, Vol. 2. Edited by Alan F. Gibson, P. Aigrain and R. E. Burgess. Wiley. \$10.50.

REFRIGERATION, AIR CONDITIONING AND COLD STORAGE. By Raymond C. Gunther. Chilton. \$17.50.

Solid State Physics. By A. J. Dekker. Prentice-Hall. \$12.



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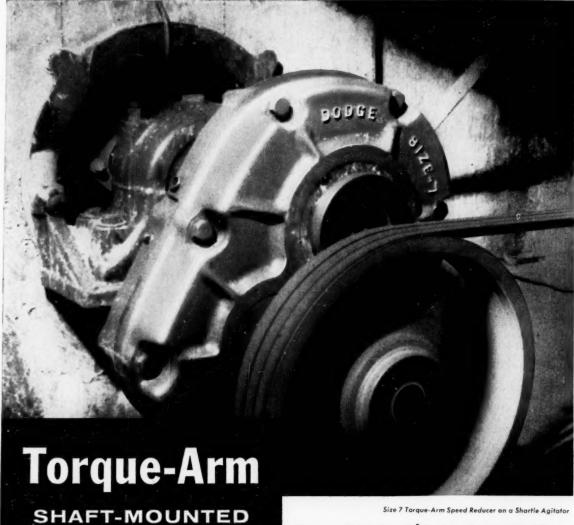
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PEOPLE ...

### MEET YOUR AUTHORS

M. A. GIBBONS



Wallace R. Gambill

HOW TO ESTIMATE ENGI-NEERING PROPERTIES. PAGE 137

Wally Gambill not only knows what he's talking about—especially on the subject of estimating engineering properties; he's actually practicing what he's preaching.

Gambill works at Union Carbide's Oak Ridge, Tenn., nuclear division, where estimations are a valuable everyday tool in his engineering calculations.

Right now, he's connected with the aircraft nuclear propulsion project, working on heat transfer and physical property studies. Along with N. D. Greene, Gambill has just come up with a real breakthrough in heat-transfer science-by demonstrating heat fluxes as high as 17 million Btu./ hr.-sq. ft. in the boiling of water. This value is about ten times larger than any previously reported in the literature for similar experimental conditions. (See Chem. Eng. Jan. 13, 1958, p. 78).

Gambill started out with Carbide just after graduation from Georgia Tech in 1952. Armed with a B.S. in chemical engineering, he was assigned to the engineering department of the firm's Charleston, W. Va., unit.

Some of his time during this period was spent doing process design work for a Dynel synthetic fiber plant. The rest of his time was spent with C. H. Gilmour in heat transfer design and special studies.

Then, for some months before

he left Charleston for Oak Ridge, he worked with A. K. Doolittle, senior scientist of Carbide's research department, on a comprehensive theory of the liquid state.



Jim Bigham

PRESSURE RELIEF DEVICES.

Chemstrand Corp.'s Jim Bigham was born and reared in Central Texas. He received an A. S. degree from Lamar College, Beaumont, Texas and a B. S. in electrical engineering from the University of Texas, in Austin.

Jim entered the electrical instrument field back in 1941. At that time, he was working for the Texas Meter and Device Co., in Waco, Texas. Soon after, he served as aircraft instrument technician in the U.S. Air Force.

In 1943, Jim started his career in industrial instruments at the Eastern States Petroleum Co. refineries in Houston, Tex. Further experience in instrument maintenance was gleaned at the Texas Co. refinery, in Port Arthur, and later at the Jefferson Chemical Co.'s Port Neches, Tex., unit. In 1950, Jim joined American Cyanamid Co. and was assigned to the Bound Brook, N. J., plant as an instrument engineer.

Eventually, Bigham was promoted to a senior engineer's post and transferred to the New York office of Chemical Construction Co. The pressure relief problems which he encountered in the design, construction and start-up of Cyanamid's Fortier.





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AUTHORS . . .

La., plant, led to the preparation of most of the material used in the current article.

In April 1956, Jim accepted the position of instrument superintendent at Chemstrand Corp.'s nylon plant in Pensacola, Fla.



#### C. J. Dobratz

THERMAL PROPERTIES FOR CHLORINE AND HCL. PAGE 144.

Author C. J. Dobratz was born in Park Rapids, Minn., in 1915. He received his chemical engineering degree at the University of Minnesota in 1938 and went on to the University of Cincinnati to earn a Ph. D. five years later.

While working on his doctorate, Dobratz was also employed by the University as an instructor in chemical engineering. Then, when he received his degree, he joined Shell Oil Co., in Houston, Tex., to do development work on fluid bed catalytic cracking.

In 1946, Dobratz pulled up stakes and headed West to join Dow Chemical Co., in Pittsburg, Calif. From that time till the present, he has worked in process design on chlorinated hydrocarbons, heat transfer, distillation, and absorption of hydrochloric acid.

Meanwhile, Dobratz has been quite active in professional societies. He has served as a member of the National Vocational Guidance Committee of the AIChE and also holds membership in the ACS. He is a registered professional engineer in the State of California.

Author Dobratz married the former Brigitta Szasz in 1942.

They now have four children: Carl, 13; Martha, 11; Ann, 9; Stefan, 7. Though he likes sports in general, Dobratz says that his present participation is limited to bowling in the plant league and fungo hitting for his son's Little League baseball team. Just now, he's also acting as scoutmaster for a Boy Scout Troop. He also admits to playing bridge and "making sawdust" in his home workshop.



Melvin Goldberg

PESTICIDES FIGURE ON BOOST FROM SOIL RANK. PAGE 102.

A chemist by education, Melvin Goldberg has specialized in pesticide sales for many years. He now keeps busy in consulting-marketing work in the pesticide field in New York City and writes extensively for agricultural trade publications.

During World War II, Goldberg was in charge of the Insecticides and Fungicides Chemical Division of the War Production Board. During the Korean crisis, he returned as a W. O. C. consultant with the U. S. Dept. of Agriculture, working with the chemical division of the National Production Administration to assure adequate supplies of materials needed for pesticides.

After World War II, Goldberg worked in production and sales for Geigy Chemical. Then, in 1948, he formed his own company—Pesticide Advisory Service—which offers consulting services and buys, sells, and processes pesticide chemicals.

In 1949, Goldberg started up a year's project to investigate the location of pesticide produc-





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tion facilities throughout the world. The project, sponsored by UNESCO, resulted in some sound recommendations.

At one time, Mel edited a regular column in *Agricultural Chemicals* magazine. At present, he's an active member of the AIC and the ACS.

Mel lives in Scarsdale, N. Y., with his wife and three children. Along with the youngsters, he's active in the Cub Scouts as well as the Little League.



Charles W. Sisler

HOW TO START A STAND-ARDS PROGRAM. PAGE 141.

Co-author, with Donald C. Brand, of this discussion of the problems in starting company standardization—and the manifold advantages that can result—Charles Sisler is, like Brand, a mechanical engineer. Both a BS and an MS in ME, he participated in a variety of engineering activities before joining Monsanto. His experience includes ship design, heavy construction and work on design and construction of electric power lines and sub-stations.

Sisler served in the Navy during World War II. He joined Monsanto as superintendent of Staff Engineering at the John F. Queeny plant, then in 1956 transferred as staff engineer to the central Research and Engineering Division.

Sisler is married and, like Brand, is an active Presbyterian church member. He is a member of the Scottish Rite and the Shrine. His technical associations include membership in ASME, NACE and the St. Louis Coatings Society, as well as committee work in ASTM.

As hobbies, Sisler studies the Law and American history. He also enjoys fishing, golf and spectator sports.



Donald C. Brand

HOW TO START A STAND-ARDS PROGRAM. PAGE 141.

Standards are becoming big news in the process industries, after a slow start which saw the most diversified possible kinds of "standards" grow up in most chemical process companies. As Donald Brand points out "there is now a revitalized interest in standardization within the chemical industry. This is manifested through the formation of the Industry Advisory Chemical Board of ASA in 1950, and the formation of the Mechanical Technical Committee just two years ago. In addition to other national activities such as the current pump standardization program and the heat exchanger standards project now before ASA, interest in company standards is on the rise as well."

Brand, a licensed professional engineer, may well be regarded as one of the pioneers in process industry company standard since the whole movement is only a few years old. A native St. Louisan, he took his Bachelor's in ME in 1944, immediately joining Monsanto as a maintenance and construction engineer. In July 1953 he started a standards program for Monsanto's Organic Chemicals Division. In December 1955 he was made manager of the Standards Section in the company's central Research and Engineering Division, which administers the over-all company standardization program.

in bulk handling

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offers every one of these important advantages

Tote System is a complete, mechanical, automatic bulk handling system. It is based on metal bins—aluminum, stainless or carbon steel, monel, or magnesium—plus filling and discharging equipment. Here is what it will do:

- 1. Tote System effects important economies by eliminating recurring container costs; eliminating product loss, contamination and deterioration; reducing labor and handling costs; reducing warehouse storage space requirements; and preserving original product quality.
- Tote System handles a diverse list of products, including liquids, both in-plant and inter-plant.
- 3. Tote System speeds up weighing and blending operations, accurately and automatically.
- 4. Tote System permits you to weigh incoming materials as a check against invoice weight, and for a permanent inventory record.
- 5. Tote System permits the use of a minimum, uncomplicated conveyor system with an accompanying reduction in clean-up and maintenance time.
- Tote System, in handling food products, meets the requirements of all existing sanitation codes.
- 7. Tote System permits complete transportation flexibility. Tote Bins can be shipped by rail\*\* or truck, or they can be left in the plant and filled from hopper cars or trucks.
- 8. Tote System can be adapted easily to future requirements. Plant layouts can be changed simply by re-locating discharge stations. Operations can be expanded merely by procuring additional Bins. And Bins can be used interchangeably for different products.
- 9. Tote System, in small and medium sized installations, requires no more labor to operate than a fixed storage bin system. In extremely large installations, another man may be required, but, in most cases, his time is more than offset by the elimination of highly-paid electronic experts needed to maintain and operate complicated fixed bin storage and conveying systems.



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Railroad Container Cars

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Rins on a car are available

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AUTHORS . . .

Outside office hours, Brand's interest runs heavily toward church work. An officer of the Presbyterian Church, he has taught an adult bible class and with his wife has sponsored a young-adult group within the church.



Richard F. Schubert

FIND DISTILLATION STAGES GRAPHICALLY, PAGE 129.

Like Co-Author Paul Horvath, Richard Schubert earned his chemical engineering degree from Fenn College, in Cleveland, Ohio. And, again like Horvath, he joined the B. F. Goodrich Chemical Co., at the Avon Lake (Ohio) Development Center, right after graduation.

Then, in November 1953, he began a two-year stint in the Enlisted Scientific and Professional Personnel program at the Army Chemical Center, in Edgewood, Md. He served on the staff of Brigadier General William R. Burns.

When he returned to Goodrich in December 1955, Schubert took on work involving pilot plant design and evaluation and process development. All told, most of his experience has centered in the fields of distillation, liquid-liquid extraction, and absorption. At present, his official post at Goodrich is that of development engineer.

Schubert spends the lion's share of his evenings doing graduate work in chemical engineering at Case Institute of Technology, in Cleveland, Ohio.

Though graduate studies eat up most of his spare time, he tells us that he manages to find time, occasionally, for music appreciation, cabinet making and photography.

The Schuberts live in Lakewood, Ohio,



Paul J. Horvath

FIND DISTILLATION STAGES GRAPHICALLY, PAGE 129.

For the last six years or so, Paul J. Horvath has been closely connected with the distillation field in one way or another.

Immediately after graduation from Fenn College in 1951, he started working for the B. F. Goodrich Chemical Co. at the Avon Lake Development Center. There, he began work on pilot plant distillation systems and became interested in diffusional operations, in general. Since that time, he has specialized in them.

Just now, Horvath's official title at Goodrich is development engineer.

Current work involves the design, operation, and evaluation of pilot plant distillation, extraction, and absorption systems.

Though Horvath and Co-author Richard Schubert had known each other in college, their work together did not begin until the Spring of 1955. At that time, they were both working on a distillation problem involving the drying of organic solvents.

Chemical Engineer Horvath is a member of the AIChE and the Elyria City Club—a service organization.

The Horvaths have three children and have just moved into a new home in Elyria, Ohio. Paul's hobbies include astronomy, coin collecting and good music—which he now enjoys on a homemade Hi-Fi set.

# 

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BS&B TANK VENT (Type 76-16) shown above features floating seal for positive shut-off under both pressure and vacuum, without using the weight of the hinged cover. Vapor pressure within the tank (or atmospheric pressure in the case of vacuum) maintains seal. Cover and major internal components are aluminum with stainless and plated steel hardware. Plastic coated bases are cast iron. These vents mount to 125-lb. ASA bolting circles. Sizes 6" through 12".



For free vent systems. May be mounted either horizontally or vertically. End connections are 125-lb.
ASA flanged for mounting to open vent lines of process vessels. Flamebank end flanges are identical to those of the Type 76-17 Arrestor Vent bases (at right). Light weight, maximum venting capacity and servicing ease are important features of the Flame Arrestor.

Combines the features of the other two types described here. Functions both as a tank breather and a cartridge-type flame arrestor to prevent ignited vapors from flashing back into the tank. Flame bank is secured by two quick-opening V-clamps for easy access to unit for inspection and servicing. Normal venting with the flame bank removed is maintained by simply securing the top unit to the base with one V-clamp. Internals of flame bank are alternate layers of flat and corrugated aluminum strips, in a continuous roll.



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Complete description, data sheets and application guide are now available. Find out how the new Twin-Lobe pump can save money, improve quality.

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PEOPLE ...

## LETTERS: PRO & CON

C. H. CHILTON

# That big yellow "26" you see here will mean a lot to you in 1958. How?

• It means 26 streamlined issues that'll be faster to read, easier to take home in your briefcase.

• It means more technical news—and more timely news in one place to cut down the total reading matter you've had to go through to keep in touch with today's fast-moving technology.

 It means more editorial pages for that broadened, exclusive coverage of process advances and engineering techniques you've been asking for.

• It means CE can now give you more—yet save you time—through faster, better, broader coverage than ever before.

• Be sure to let us know what you think of the job we're doing; this will help us serve you—as well as all chemical engineers—even better in the future. Simply address your letter or postcard to Editor, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.



#### Filing Systems, 29 to 1

Sir

I strongly agree with Mr. Weissman (Dec. 1957, pp. 344-5) that some sort of classification system for filing engineering information has been needed for a long time.

Nearly all engineers maintain their own information and data files, especially in their early professional years. These files become more and more valuable to the individual as time goes on.

However, much of their value is lost because of the engineer's inability to locate the desired information at the time it's required. Too many of us start files along a line of reasoning suited to our first job, then change jobs and find out that our filing system is no longer applicable and must be completely overhauled. After a couple of job changes it becomes too much

effort to rearrange the files, so they are just forgotten, and a lot of good effort and intentions go down the drain.

I disagree with Mr. Weissman that the file index reference should be printed on each article in your magazine. Engineers in different fields might consider the same article as belonging in different categories; this would only make the system cumbersome, and it would be quickly discarded.

Actually, the perfect system might specify only major categories and subsections and allow the individual engineer to complete the details according to his own requirements.

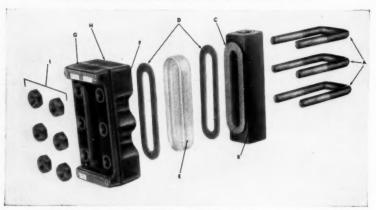
WILLIAM L. SUYDAM, JR. Ciba Pharmaceutical Products Summit, N. J.

Sir

I concur heartily in Mr. Weissman's opinion that a decimal

# Penberthy Gages give you EXTRA FEATURES AT NO EXTRA COST

CLEAR, ACCURATE LIQUID-LEVEL READINGS in all tanks, boilers, vessels, containers, flow lines.



#### PENBERTHY REFLEX GAGES TYPE V & S



- A Alloy Steel Bolts for high temperature service.
- B Alloy Steel Liquid Chamber heat treated ... no warping.
- C Raised Face on Liquid Chamber insures perfect self-alignment of frame with glass and gasket.
- D Composition Gaskets and Cushions are interchangeable.
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- G Extra heavy beam at end of Frame (prevents distortion).
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- I Alloy Steel accurately threaded nuts.

The "inside story" of Penberthy Liquid Level Gage construction shows why you get positive-accurate readings at temperatures from sub-zero to over  $750^{\circ}$  F; up to pressures exceeding 10,000 psi.

Exclusive features assure long service (at no extra cost) in all types of applications...even with highly corrosive and dangerous chemicals. Maintenance is much simpler; replacements and repairs made without removing assembly from vessel.

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PRO & CON . . .

classification system for chemical engineering knowledge would be very valuable.

For some years I have been using the Bolles system, with a few modifications to suit my own individual needs. With this system I find that, in a matter of seconds, I can lay my hands on a particular report, or on all the material I have on file concerning any given subject.

Mr. Weissman says that he abandoned the Bolles system because he found it too time-consuming and because it lacked an alphabetical index. I am rather surprised at the first objection; I classify and file my accumulation of new material about once a month and find that assigning the numbers rarely takes more than a few minutes.

Regarding the second objection, an alphabetical index would be useful, but my experience has shown that lack of one is no serious handicap. In any event, it would not be difficult to develop an alphabetical index for use with the Bolles system or with any other system.

A. C. MALMSTEN

Dow Chemical Co. Midland, Mich.

Sir:

Mr. Weissman's suggestion regarding a classification system for chemical engineering knowledge is interesting but, in my opinion, has little practical value at this time.

I have used the Bolles system, adapting it for my personal files to my entire satisfaction. I have deleted some of Bolles' detailed breakdowns, added others, modified some. These modifications suit my own needs, but not necessarily those of the next person.

Bolles has presented an excellent basic classification, and at least one chemical company has adopted it in toto. I have studied other systems also and have observed that each differs completely from the next while perfectly suiting the needs of a limited group.

To be sure, any system you may come up with will undoubtedly be useful to some readers but will have little or no value to others who already are using another system. Indeed, I do not believe a project undertaken by

Chemical Enginering could lead to a significant contribution in this field.

BURTON H. SANDERS National Research Corp. Cambridge, Mass.

► We're extremely gratified by the way many of you have taken time to write us, some in very thoughtful detail, about the problems of classification and filing of chemical engineering information. Of the letters received to date (some 30 in all), only Mr. Sanders' recommends against our undertaking a project in this field.

In view of this overwhelming support of Mr. Weissman's suggestion, we are studying the situation carefully and expect to come up with a definite answer to this need.

—ED.

#### Dacron vs. Dacralon

Sir:

We were pleased to read in your Inventory Issue (p. 207) your comments on the fabric of Dacron polyester fiber coated with Hypalon which the U. S. Air Force uses to provide radar shelters with lightweight protective coverings that won't interfere with efficient transmission of microwave energy.

We were concerned, however, when we saw this cloth still being referred to as Dacralon, because we believe that this term infringes our trademark, Dacron.

DeBell & Richardson (Hazardville, Conn.) developed this new product in cooperation with the Air Force's Rome Air Development Center at Griffiss Air Force Base. They originally called it Dacralon. However, both DeBell & Richardson and Rome Air Development Center have since offered their full cooperation to have the use of this term discontinued.

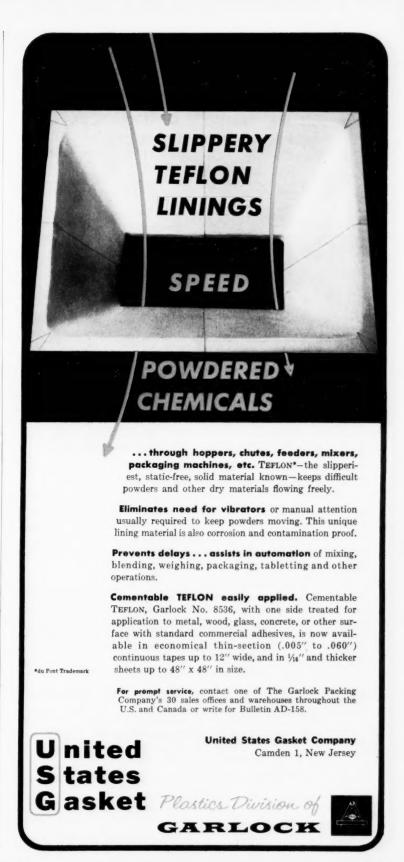
P. M. COURTNEY E. I. du Pont de Nemours & Co. Wilmington, Del.

#### **Public Education Needed**

Sir:

I have just seen a copy of your comments in the Inventory Issue (pp. 479-482) which took up particularly the Blank-Stigler book.

My sentiments in regard to this book are even more bitter than yours.



# RECIRCULATION MAY BE KEY TO FUTURE GROWTH OF CHEMICAL AND INDUSTRIAL PROCESSES

How much water do you need to make: a ton of steel? a ton of synthetic rubber? a ton of bromine? a barrel of beer?

These are not empty questions. They point to a critical problem which confronts management today in its plans for tomorrow. It is more critical than most of us realize... for industry today uses as much water as all other users.

#### Industry's Needs in 1975

Water is vital for chemical and industrial growth. By 1975, industry will require 215 billions of gallons daily. That is a 100% increase over our current industrial consumption... more than we currently consume for all uses combined.

Competing for this water will be irrigation farmers and the general public. Their combined needs by 1975 will be up 40 billion gallons a day... possibly even more.

#### What is the Supply Picture

More than 40% of the communities in the United States already have a critical water supply problem. Yet, to meet the 1975 needs, our supply must be expanded by 50%, at an estimated cost of \$50 billion.

Indications are that industry is going to have to bear its part of this cost. Certain communities are already moving to place flat water rates on all users... regardless of the volume used. Other groups are demanding a national water policy with full Federal Government regulation of natural sources.

#### Chemical Industry's Stake

Shortage of water can be a most serious threat to the expansion hopes of the chemical industry. A glance at the following table shows why. You need approximately:

20,800	tons	01	water	per	ton	10	Bromine
2,500	2.3	99	9.9	9.9	99	99	Synthetic rubber
830	9.9	33	11	99	2.2	99	Viscose rayon
300	**	9.3	22	9.9	99	99	Newsprint
208	**	9.7	0.1	9.9	11	9.9	Smokeless powder
15	22	23	2.2	22	2.5	22	Coke from coal

While process refinements may be able to reduce slightly the amount of water needed for each product, the gains will be minor.

### Difference Between Use and Consumption

This is best illustrated by the water needed to make a ton of steel. The industrial average is 65,000 gallons (271 tons). In the past, 65,000 gallons of water flowed out of a river through the steel mill and back into the river again for each ton of steel made. In this case, use and consumption are one and the same thing.

On the west coast, a large steel mill now requires only 1,100 gallons of makeup for each ton of steel produced. This steel mill has its own recirculation system which holds several million gallons of water.

This water is recirculated at a rate equal to 65,000 gallons per ton of steel produced. The only water consumed is that lost due to evaporation or through leakage. Thus, net consumption has been reduced to 1,100 gallons.

#### Two Bulletins Available

One of the most important pieces of equipment in a recirculation system is a filter. Where high quality process water is needed, diatomite filters will provide an effluent second only to distilled water. Bulletin 651, released by the R. P. Adams Company, Inc., 507 E. Park Drive, Buffalo 17, N. Y., covers this type of industrial water filter.

A second publication, Bulletin 909, covers an Automatic Water Filter which is frequently used in recirculation systems where the water is used for less critical applications. This bulletin is also available on request from the R. P. Adams Company at the above address.

By the way, it takes almost two tons of water to brew a barrel of beer.

## CONSERVE WATER, OUR MOST VALUABLE NATURAL RESOURCE

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We have a probler Name Company	m involving liquid filtr		

Not only did the authors err in the directions you have indicated, but they used in their Table XI data on salary situations for people in four professions and claim that the engineers were below all four. In two of the four—lawyers and teachers—the engineers were almost exactly at the same level. In the other two—medicine and dentistry—the authors neglected to state that in neither of these professions did a free market exist on the supply side.

The medical schools feel unhappy if they don't have at least two candidates for admission to turn away for every one they take; sometimes the ratio has been as high as five to one. Last year the dental schools turned away several times as many applicants as they could admit.

HARRY F. LEWIS Institute of Paper Chemistry Appleton, Wis.

Sir:

I have read with interest your remarks on the Blank and Stigler book in the Inventory Issue (pp. 479-482). I have some thoughts of my own, as per the enclosed.

HARDING BLISS

Yale University New Haven, Conn.

▶ Prof. Bliss's editorial in AIChE Journal is headlined, "Grimm and Andersen: Move Over." We take the liberty of quoting from it:

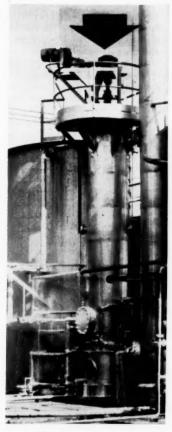
"The book The Demand and Supply of Scientific Personnel" (Blank and Stigler) could be described as a modern fairy story if it were not such dull reading. In this book the authors attempt to prove that there has not been and there is not now a shortage of engineers. This conclusion seems little short of fantastic, at least to one in university teaching, where the corporate recruiters are so thick one can scarcely see the elms....

"The emphasis on salaries leads the authors to make doubtful statements, dismissing contrary evidence. . . .

"The ignorance of the engineering profession exhibited by these authors stems largely from the government statistics. If one approaches statistics without imagination one will come up with some odd answers....

"We can take at least one lesson from this book. There is a great ignorance of the nature of the engineering profession even on the part of the nominally wellinformed. We should be wise to present our profession more effectively to the public."

AIChE and its Public Relations Committee have a job ahead.—Ed.



## Con: Anonymous Equipment Sir:

The article in your November issue, "New Team Licks Phenolic Waste Problem" (pp. 148-150), fails to identify completely an important member of this team. You should have credited the Turbo-Mixer Div. of General American for the commercial development and manufacture of the RDC extraction column.

VIRGIL J. BUSTO Genl. American Trans. Corp.

Chicago, Ill.

▶ While we don't attempt to identify the manufacturer of each item of equipment mentioned in our plant and process stories, we agree with Mr. Busto that the RDC's contribution to success of the wastedisposal installation merits identification of its maker.—ED.



Why did we send this drum of caustic on a winter cruise?

This is our way of reminding you that the caustic that flows *best* in the summer is, of course, the caustic you should use in the winter, too.

If you're one of the many who were prudent enough to use Wyandotte Flo-chilled Anhydrous Caustic Soda last summer — you know what we mean. It's free-flowing always.

Call your Wyandotte representative or distributor NOW. It costs no more than ordinary caustic.

Look for this label . . . and be SURE!



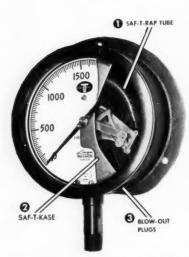


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# "TRIPLE-THREAT" SAFETY...



# LONERGAN'S NEW PRESSURE GAUGES

New SAF-T-RAP Tube . . . special industrial tape wrapping which confines or smothers explosive effect when tube is ruptured.

New SAF-T-KASE places an armor plate between dial and tube and movement assembly—thereby containing any explosive force within the cast housing.

New BLOW-OUT PLUGS (Safety Vents) . . . provide positive insurance against any pressure build-up within the gauge . . . slightest pressure causes plugs to drop out.

Another big plus feature for new Lonergan SAF-T-RAP Gauges is bored steel tubing, carbon or stainless . . . a special machine rifle bores the tubes, producing a "mirror-like" finish which decreases the possibility of rupture and adds to the life of the gauge (it has been proved that tubes will often rupture at the point where there is a tool-score).

And, all of these features for greater safety and longer life are available with Lonergan SAF-T-KASE Gauge with SAF-T-RAP Tube. Write for further details.

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Lonergan company

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### NAMES IN THE NEWS

M. A. GIBBONS



W. E. Hanford

W. E. Hanford has been appointed vice president for research of Olin Mathieson Chemical Corp.

Since joining Olin Mathieson last July, Dr. Hanford had been assistant to the president for research. Before that, he was vice president and director of M. W. Kellogg Co. He had been director of research of General Aniline and Film Corp. and, before joining General Aniline, spent seven years with Du Pont.

Hanford holds more than 100 patents in the U. S. and abroad. He has made important contributions to the development of nylon, polyethylene, polyesters, elastomers and acetylene chemistry. He also was a leader in the development of the chemistry of fluorocarbons.

John P. Powell has been named vice president-general manager of American Vulcathene Division of Nalge Co., Rochester, N. Y. American Vulcathene specializes in corrosion and acid-resistant polyethylene pipe fittings and accessories.

S. J. Wommack has been named assistant general manager of the nuclear fuel division of Olin Mathieson Chemical Corp. In his new position he will direct activities of the production, technical and quality control departments.

G. H. Short, C. W. Forman and H. D. Trotter are three newly appointed plant managers for Phillips Chemical Co.'s manufacturing facilities in the Texas Panhandle. Short will be manager of Plains butadiene plant, near Borger; Forman, formerly at Dumas, will be manager of the adjacent Plains copolymer plant; Trotter will manage the Cactus plant where the company operates ammonia, ammonium nitrate and nitric acid facilities.



Edgar A. Haine

Bakelite Co. has announced the appointment of Edgar A. Haine as general superintendent of its plant at Ottawa, Ill.

Haine joined Bakelite in 1936 at Bound Brook. He served as an Army lieutenant colonel in World War II and returned to Bound Brook in 1946 as assistant to the industrial relations director.

He was promoted to assistant superintendent for industrial relations in 1947, assistant superintendent for phenolic molding materials production in 1952 and assistant for vinylite and polyethylene production in 1956. He was appointed services superintendent at Bound Brook in 1957.

Edward J. Fradkin, project manager with Scientific Design Co., N. Y., has flown to Tokyo to supervise a team of 15 Japanese engineers on the detailed design of Nitsui

# Get A Better Job At Less Cost With CRESCENT ARMORED MULTITUBE®

CRESCENT ARMORED MULTITUBE is a group of 2 to 37 tubes of copper, aluminum, steel or polyethylene spirally cabled together and protected by a flexible, interlocked galvanized steel armor, or by a tough corrosion resistant thermoplastic sheath, or a combination of both.

The SPIRAL CABLING of the tubes permits easy bending to a small radius without distortion of the tubes. It can be installed with great saving in time.

Special constructions are available for underground runs. This product is licensed under U.S. Patent 2,578,280.

IMPROVED CABLED TUBING

Carries Air, Gas or Fluid

CRESCENT ARMORED MULTITUBE completely out-dates the old method of using single tubes with users reporting savings in installed cost of from two to five times the cost of the multitube. In addition, the MULITUBE system will result in fewer connections and fittings, lower cost for supports or racks, ease of mounting and less space.



Plastic Coated Single Tubes, copper or aluminum, should be used to give corrosion protection to all single lines up to the final tube fittings, where trouble from corrosion may occur.

SEND FOR BULLETIN 356-H GIVING COMPLETE INFORMATION AND ENGINEERING DATA

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No. 1010 steel plates welded to haxagon hub. Thoroughly suitable for all applications in which iron or cast steel propellers would otherwise be used.

# with MICHIGAN'S NEW and radically different "FABRICATED" PROPELLERS!

NOW, for the first time in history, you can obtain "fabricated" propellers so accurately balanced and pitched they will do a perfect job of mixing, blending, stirring, pumping or aerating in any application requiring relatively low horsepower and not over 1750 RPM. Our very specialized, recently developed process of fabricating these wheels results in real costsavings, considerably lower prices to our customers and far quicker deliveries. They are available in all standard sizes from 6" thru 24" diameters, right and left turning . . . in stainless steel polished to a "Dairy Finish" and 1010 Steel. If you are using wheels in these categories by all means investigate the new MICHIGAN FABRICATED PROPELLERS. It's bound to pay you big dividends in time and money savings. Write for your free copy of our new INDUSTRIAL PROPELLERS CATALOG.

## MICHIGAN WHEEL CO.

GRAND RAPIDS 3, MICH.



#### PROCESS TANKS COST LESS LAST LONGER



# ... compared to expensive alloys!

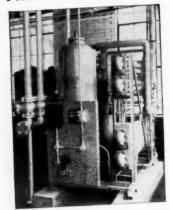
Atlas offers you economical process tank construction that will give you longer trouble-free life. This is accomplished by the use of a mild steel or concrete shell protected by corrosion-proof linings and acid brick sheathing jointed with corrosion-proof cements. These Atlas tanks are impervious to today's stronger chemical solutions and higher operating temperatures.

Aii metals have a real solution rate that may contribute to contamination of the product but Atlas tanks offer complete protection against this possibility. In addition, Atlas construction is far less costly to install than expensive alloys and the tanks are corrosion-proof inside and out.

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Many exclusive features of the Pritchard HYDRYER make it ideal for low-cost drying of instrument air as well as compressed air for air control systems. Features such as:

- NO WASTE—100% of all air entering the HYDRYER is dried without loss
- FULL LINE PRESSURE REACTIVA-TION-Pressuring and depressuring of adsorbers between cycles is eliminated
- NO PURGING—The Type A HYDRYER
- LONGER ADSORBENT LIFE
- NO MOVING PARTS
- SIMPLIFIED OPERATION
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. . . and many other proved advantages.

Goe: This is what we were talking about.

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of HYDRYER Bullitin 16.0.081

Their address is-

J.F. PRITCHARD & COMPANY of CALIFORNIA Dept. 573, 4625 Roanoke Parkway Kansas City 12, Missouri

P.S. but letter in the mail TODAY Ben

NAMES . . .

Petrochemical Industries' new terephthalic acid plant. Expected to go on stream later this year, the 15 million-lb.per-yr. plant will produce terephthalic acid and aromatic intermediates via SD's liquid - phase, air - oxidation process.

Thomas J. Hanratty, assistant professor of chemical engineering at the University of Illinois, received the 1957 Junior Award of the American Institute of Chemical Engineers for his outstanding contributions to chemical engineering literature.



Fred Royse

Fred Royse, sales manager of Fluor Corp., Ltd., Houston sales office since 1946, has been promoted to the newly created post of vice president, sales, for Fluor Corp. of Canada, Ltd.

A chemical engineering graduate from Rice Institute, Royse has been active in the oil industry for the past 27 years.

Following graduation in 1930, he worked in Texas Co.'s Port Arthur, Tex., research lab. In 1932 he went with the Tenmant Co., Houston, Tex., as a sales engineer.

From 1935 to 1941 he was a member of Humble Oil Co.'s technical services staff in Houston. He left there in 1941 to become a sales engineer for the Griscom Russell Co.

James E. Seebold, Arthur P. Lien and Nathan Fragen are three new directors in Standard Oil Co. (Indiana) research department. Seebold

is director of development; Lien is director of petroleum research; Fragen heads up chemicals research and development.

M. F. Lipworth has been named to head the operations department of Truland Chemical Co., Division of Trubek Laboratories, East Rutherford, N. J.



C. C. King

M. W. Kellogg Co. has announced the appointment of C. C. King as manager of the process engineering department.

King, who has been with Kellogg since 1939 and was made manager of the chemical process division in 1952, is well known for his work in both petrochemical and petroleum refining fields. Recently he has been closely associated with the development of processes for ethylene, acetylene and butadiene, and has authored papers and patents on alkylation and ethylene.

During World War II, King was in charge of the process group which designed the gaseous diffusion plant, K-25, at Oak Ridge, Tenn.

Sylvester Grant, Jr. has been promoted to the post of technical service representative with Sohio Chemical Co. He will assist the company's director of agricultural technical services.

W. W. McLean, head of process development department of Union Carbide Chemicals Co. at Texas City, Tex., has been made production manager for



# THE ALL PLASTIC VALVE THAT DEFIES CORROSION

VALCOR's all plastic, corrosion-resistant solenoid valve, SV-5100 series, is the only solenoid valve that has no metal contact with the fluid—ever. Specifically designed to handle most of the corrosive media so widely used in industry, VALCOR's new, all plastic solenoid valve will, in many cases, outlast stainless steel valves 100 to 1.

If you have a corrosive media problem, from sulphuric acid solutions to citrus juices try this new VALCOR valve on your toughest application. Prove for yourself how this new valve defies corrosion. List prices start at \$8.50.

**IMPORTANT:** Hundreds of other valve variations, in design and pressure ratings, are inherent in this new SV-5100 series. By incorporating some of the very newest engineering and chemical formulas, we can offer valve variations designed to meet almost <u>any</u> corrosion problem you might be faced with.

Write today for new catalog sheet. For specific information, please send us pertinent application details.

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# ALL-NEW DRY CHEMICAL EXTINGUISHER KILLS FIRE FASTER, EASIER!



Kidde's new pressurized dry chemical portables awarded top U.L. rating! This means you can attack flammable liquid or electrical fires with confidence. Automatic unlocking device and trigger control mean easier, faster operation. Just follow simple directions . . . REMOVE HORN, PULL TRIGGER—instantly dry chemical knocks out fires. Other new features include extra-large aluminum handle—use with gloves on. Center-balanced—easier to carry. The plastic-faced pressure gauge is recessed for protection, tells at a glance if unit is ready to use. Available in b.th 20 and 30 lb. capacities.

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Check appropriate box, tear out, mail this coupon for prices, literature!

- Please send me your new P-40 fire extinguishing and detecting equipment catalog.
- Please send me prices and specifications for your new dry chemical extinguisher.



NAME	
ADDRES S	

ITY\_\_\_\_STATE

NAMES . . .

the new subsidiary, Union Carbide Caribe at Ponce, Puerto Rico.

Ernst Weber has been elected sixth president of the Polytechnic Institute of Brooklyn. He succeeds Harry S. Rogers who died last June.



T. H. Rogers

T. H. Rogers, director of research for Standard Oil Co. (Indiana) retired January 3 after 35 years with the company.

At Standard, Rogers' early researches dealt principally with anti-oxidants, white oils, finishing of distillate fuels and motor oils. His later activities cover the entire field of petroleum chemistry. He is the author of many patents and publications in these fields.

Over the years, Rogers advanced from assistant chief chemist to assistant director, associate director and director—a post which he held for the last 10 years.

Frank D. Allen, formerly general sales manager of Sprout, Waldron & Co., has been named sales manager of Archer-Daniels-Midland Co.'s new equipment department.

Fred S. Miller, winner of the 1955 American Rocket Society Hickman award, has been promoted to manager, solid propellant production, at Aerojet-General's solid rocket plant at Sacramento, Calif. J. B. Cowen, formerly executive assistant to the company's vice president-manufacturing, has been appointed manager of manufacturing at the Sacramento plant.

Arnold A. Butterworth, Jr., has been named an assistant to the sales manager of Dow Chemical Co.'s plastic department. He served previously as head of industrial chemical sales for the company's Camden, N. J., office.

Edward Eaton has been named resident European technical manager for Godfrey L. Cabot's Paris, France, office. Harry Collyer has been appointed manager of foreign technical service in the company's Boston office.

C. J. Windsor, manager of Reichhold Chemicals' Detroit plant, has been appointed to the newly created post of vice president-manufacturing.

Robert S. Buffum has joined Borden Co.'s chemical division as a project engineer in the Polyco-Monomer department. He will be located at Leominster, Mass., the department's engineering headquarters.

John L. Liebenthal has accepted a position with the atomic energy division of Phillips Petroleum Co. He will be employed as a plant engineer at the engineering test reactor.

Irb H. Fooshee has been appointed president of General Chemical Division, Allied Chemical & Dye Corp. He succeeds Chester M. Brown who was recently made a vice president of Allied.

Glenn C. Vickery has been named chemical sales representative for General Tire & Rubber Co. He will cover the Middle Atlantic States.

Fred J. Holzapfel has been named associate director of engineering of Monsanto Chemical Co.'s organic chemicals division. Harry M. Walker has been made assistant to the director of the newly organized development department of Monsanto's



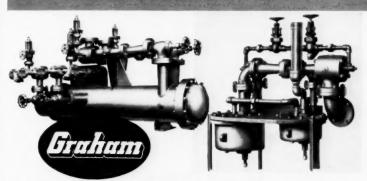
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You cannot afford to overlook the possibilities of a Graham Steam Jet Ejector—our recent developments have permitted us to really "gild the lily". And the Graham laboratory at Batavia, New York is constantly exploring new fields of vacuum application.

Graham sales engineers are located in the following cities. You are invited to consult them without obligation.

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Havana, Cuba
Houston, Tex,
Kansas City, Mo.
Los Angeles, Calif.
Mexico D.F., Mexico
Minneapolis, Minn.
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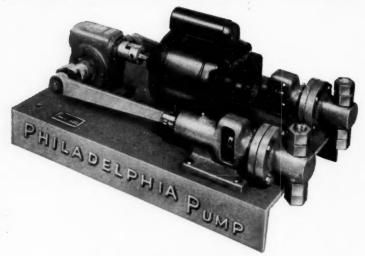
Philadelphia, Pa.
Pittsburgh, Pa.
Richmond, Va.
Roanoke, Va.
San Francisco, Calif.
Seattle, Wash.
St. Louis, Mo.
Toronto, Ont.
Tulsa. Okla.



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Accuracy and low maintenance to meet fluid proportioning requirements in Chemical Processing, Refining and Boiler Feed Applications.

Philadelphia proportioning pumps feed precisely metered fluids or slurries into low or high pressure systems in nearly any desired ratio with flow, temperature, pressure, conductivity, PH and other controlled process variables. Control may be manual or automatic—with electric, hydraulic or pneumatic systems.

Models may be obtained to handle a great variety of "tough," corrosive and viscous materials. Write for full information.

# PHILADELPHIA PUMP

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High-Pressure Pumps • Controlled Capacity Pumps • Chemical Feed Systems

NAMES . . .

plastics division at Texas City, Tex.

Marlin G. Geiger, in addition to his present position with W. R. Grace as executive vice president in charge of chemical divisions, has been named president and chairman of the board of the newly formed International Metalloids, a Puerto Rican subsidiary of Grace International S. A. The new company will produce ultra-high purity elemental silicon.

Donald A. Bender has been elected vice president of Carwin Co., North Haven, Conn. His duties will be broadened to include responsibility for the operations of the company's chemical division.

Kenneth A. Matticks has been named to the newly created post of manager of product development for Crucible Steel Co.'s stainless steel sales division. In his new capacity, Matticks will be responsible for technical and other services to Crucible's stainless steel customers.

H. J. Hodgins, of Vancouver, B. C., has been appointed vice president of the timber division of Crown Zellerbach, Canada, Ltd.

J. E. Helbig and G. M. Marcus are new members of Humble Oil & Refining Co.'s research and development division at the company's Batown, Tex., refinery.

Paul J. Franklin, Jr., has been promoted to the post of assistant operations manager and Howard L. Weightman to the job of field service manager with Kaiser Gypsum Co. Both men will be headquartered in Oakland, Calif.

Donald F. Mastick has been appointed to the position of assistant to the vice president, research and development, with Stauffer Chemical Co., Richmond, Calif.

Gradon F. Willard has been appointed production manager

of the Muskogee division, Callery Chemical Co. Oscar J. Seltzer, safety engineer; Stanley E. Dale, chief process engineer; Howard E. Harlan, area superivisor and Robert L. Scholtz, project engineer, have been transferred to the Muskogee division.

Robert C. Wheeler and Alfred S. Wells have been named executive vice presidents of Corn Products Refining Co. Wheeler will be responsible for personnel and public relations; Wells, for purchasing.

Raymond J. Severson, former assistant general sales manager of Ampco Metal, has been named manager of the company's new branch in Garland, Tex.

Fred Walworth has been named manager of Archer-Daniels-Midland Co.'s fatty acids department.

Henry L. Ford has been elected a vice president and W. Chamberlain Hale an assistant vice president of Tennessee Eastman Co.

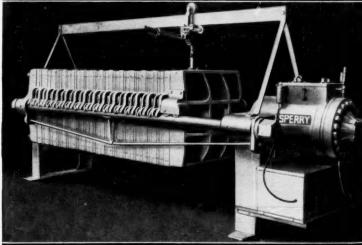
Dewey H. Nelson has been promoted to assistant manager of Becco Chemical Division, Food Machinery and Chemical Corp. He will continue as sales manager, a position he has held since last November.

Van Zandt Williams has been named executive vice president of the Perkin-Elmer Corp. Before joining the firm in 1948, Williams was with American Cyanamid at its Stamford, Conn., research laboratories.

Thomas E. Smith and Walter J. Blaha have joined the chemical plant engineering department of Pittsburgh Coke & Chemical Co.

C. E. Frick, 34-year veteran at the Dutch Brand Div. of Johns-Manville Corp., has been promoted to the newly created post of manager of technical services.

## LOW DOWNTIME



# with a plate and frame SPERRY FILTER PRESS

If your present filter system is inadequate to meet increased production demands . . . if excessive shutdowns, cleaning and manpower problems are dragging out your filter cycle so as to slow down your production cycle — now is the time to investigate all the advantages of a plate and frame filter press — as modernized and custom engineered to your particular application by D. R. Sperry & Company.

Through extreme versatility of design, a Sperry Filter Press can simplify the most complex filtration requirements. Varying batch sizes . . . incompatible products . . . cake removal . . . and constant cleaning cease to be problems. Instead — the cycle is reduced . . . filtering area and pressures are increased . . . downtime losses are reduced to a minimum . . . and with labor-saving automatic closing attachments and plate shifting devices, complete control is reduced to a one man operation.

Sperry Filter Presses are available in a design and capacity to handle any filterable mixture and any filter material . . . with center, side or corner feed; open or closed delivery; high or low temperature control; and your choice of labor saving devices.

FOR A LOW-COST ANSWER TO YOUR FILTRATION PROBLEMS, SEE THIS SPERRY CATALOG . . .

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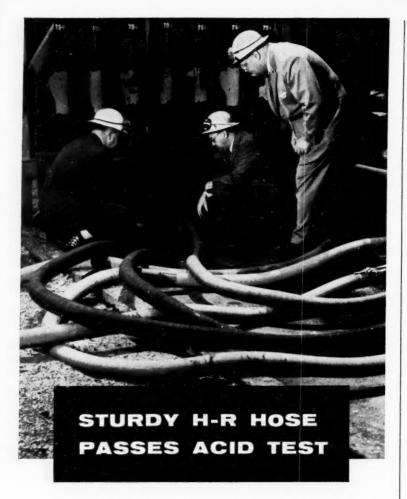
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No one can afford to be careless with hydrochloric acid. That's why this large Louisville, Kentucky, chemical plant uses rugged H-R acid hose. The dependable long performance and acid resistance of H-R acid hose can be counted on to meet the tests provided by the most corrosive chemicals.

Here is a hose designed to carry all concentrations of arsenic, citric, gallic, hydrobromic, hydrochloric, phosphoric, and tannic acids; up to 50% concentrations of sulphuric acid, strong alkalies such as ammonium hydroxide and sodium hydroxide, and many other problem chemicals.

H-R acid conducting hose, acid pinch valve hose, and acid suction hose have been proved the safe, dependable hose on the job under the most vigorous use of chemical plants, steel mills, and tanneries. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Connecticut.

## HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS...POWER TRANSMISSION DRIVES INDUSTRIAL HOSE...VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

NAMES . . .

#### **OBITUARIES**

James H. Critchett, who retired in 1947 as vice president of several divisions of the Union Carbide and Carbon Corp., now the Union Carbide Corp., died December 18 at his home in Orleans, Mass. He was 71 years old.

John V. Hilton, 54, manager of International Paper Co.'s Long-Bell division at Cathlamet, Wash., died December 24 following a heart attack.

#### ---EAVESDROPPING



William J. Kroll\*

"We must offer the recalcitrant lonewolf searcher a kind of asylum since this useful species is lately menaced by extinction."

"The fight of the individual against the collectivity in which he lives is as old as humanity, and it will never cease.

"Our educational system, that is heavily contaminated with Sigmund Freud's psychology of "no compulsion" (which leads to conformism), has thrown overboard the pioneer and has tried to replace him by the democratic team. Granted that the latter cannot be avoided in development work, is the team justified in research? In group work, the individual has to conform, to subordinate, and competition is ruled out since it would ruin mutual understanding.

"How is leadership going to be created in such a system? When teams are put to work to make important discoveries or inventions, they either flop awfully, or are far too costly.

"The individual inventor pitches his ingenuity against the financial means of his team competitors. The Curies did not need more than a shack in which they worked to lay out the basis of our atomic age and to fulfill their mission. Fleming did not need more than a few dishes with cultures to create penicillin. . . .

"In the United States, many laboratories of our country are overgadgeteered and drowned in complicated equipment that frequently takes more time to fix, than to use. These instruments remove the searcher from his experiment, the recorder replacing the live observation by man. . . .

"We must offer the recalcitrant lone-wolf searcher a kind of an asylum, since this useful species is lately menaced by extinction. High taxes, competition by government and corporation laboratories have made his life quite precarious.

"What he wants is freedom first, to satisfy his mystic needs, the artist's way. . . .

To try to domesticate, collectivize and depersonalize him in a team is therefore, psychologically speaking, a fatal mistake. He will keep his allegiance to the group only as long as its goals coincide with his. If these don't fall in his line, he will become sterile or quit.

"But collectivization and mind conditioning has progressed. Individualism and deviationism, even when entirely ascetic, is frowned upon, here as well as in Russia, in both countries for different reasons. Another Steinmetz would probably be turned down at the plant doors as an eccentric, if he looked for a job with his old company today, since he would not fit the pattern of the psychologist's organization man.

"Very great discoveries, in my opinion, still lie so close to the surface that they can be unearthed with little expense by nonconforming individuals with an inquisitive mind, with knowledge, with the holy urge to create, and who are willing to accept sacrifice as a way of life."



#### DAY 5 x 12 MILL

allows you to make more profit on short orders. Features include:

- Rugged heavy duty construction
- · Feed hoppers
- Day Hydra-Set as optional equipment

increase your profits three ways



DAY 4 x 8 LAB MILL

saves time because you get the answers quickly and accurately.

Features include:

- Either fixed or floating roll operation
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DAY PRODUCTION MILL

saves time and money by virtually eliminating "downtime", because of precision engineered, rugged construction.

- Available in 10 x 22 and 14 x 30 sizes
- All standard production mills are readily converted to either fixed or floating roll operation
- Day Hydra-Set available as optional equipment



in mixing equipment



means longer life span

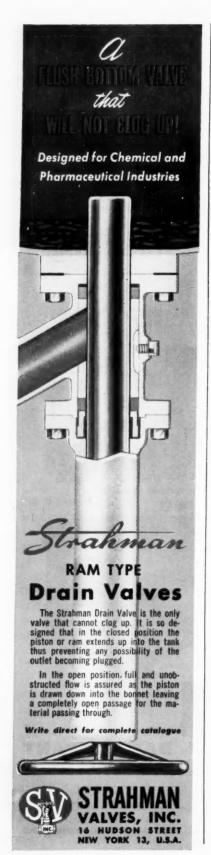
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Quality equipment for baking, paint and varnish, printing ink, chemical, rubber, pharmaceutical, cosmetics, paper and pulp, explosives, food, ceramics, candy, soap, sugar and milk products.

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<sup>•</sup> William J. Kroll, consulting metallurgist of Corvallis, Ore., expressed his views in an address accepting the 52nd Perkin Medal of the American Section of the Society of Chemical Industry, at the Waldorf Astoria, in New York, on January 19.



PEOPLE ...

## FIRMS IN THE NEWS

J. B. BACON



Nuclear-Chicago Corp. is now offering a college nuclear engineering package which includes a small, water-moderated, natural uranium subcritical reactor.

Atomic Energy Waste Disposal Service has added an atomic waste container rental service. Rented containers placed on premises receive all radioactive waste prior to pickup.



Bal-Tate Furnace Co., Royal Oak, Mich., has been formed to manufacture and sell a new liquid-glass heating furnace; rotating furnace protects and heats with uniform covering of molten glass.

Stephen F. Malaker Associates, Newark, N. J., has established an industrial consulting service offering technical, economic and legal advice in field of nuclear energy.

Plas-Tech Equipment Corp., with headquarters in Waltham, Mass., has established a complete consulting service for plastics industry. Firm also manufactures new highspeed plastic-testing machine.

Interatom, a firm developing peaceful uses of atomic energy, has been established in West Germany by North American Aviation and Demag, AG., of West Germany.

Crucible Steel International, S.A., is the new sales and service company for Crucible Steel Co.'s export markets.

Process Power Corp., a new engineering and construction company located in New York, N. Y., offers a complete design and construction service for industrial expansion and modernization projects.



Bakelite Co. will be producing 15 million lb./yr. liquid epoxy resins by early 1959 from a new plant in Marietta, Ohio.

Pittsburgh Plate Glass Co. will start construction in March on a multimillion-dollar window glass plant located near Decatur, Ill. Completion is slated for mid-1959.

Shell Oil Co. of Canada is due to start construction on a \$600,000 solvent manufacturing plant at its Shellburn refinery in Burnaby. Previously, solvents for paint, varnish and dry cleaning industries have been imported from the U. S.

Ciba Pharmaceutical Products has opened a million-dollar laboratory facility at Summit, N. J., devoted exclusively to industrial pharmacy research and development.

Houdry Process Corp. is engineering a 20,000-ton/yr. dehydrogenation unit for ANIC of Italy. The butadiene installation will be located at Ravenna, Italy, where ANIC is erecting a synthetic rubber plant.

Pfizer has opened a new plant at Santiago, Chile. Plant, equipped to produce fine an-



## materials

brass, stainless steel, lead, hard rubber, hardened steel, tungsten carbide and many others.



uniform distribution with spray angle, capacity, impact and atomization to your specifications.





## to improve every spraying operation

Improve performance, lower spraying costs with Spraying Systems spray nozzles. Prompt delivery. For complete information write for Catalog 24.

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ADVANCED SPRAY NOZZLE DESIGN FOR NEW

#### A FAITHFUL GUARDIAN THAT NEVER SLEEPS



#### HENSZEY BOILER FEED REGULATOR Set it... Forget it

Rest assured . . . you can always depend on this rugged Henszey Regulator. It automatically guards boiler levels night and day with untiring vigilance. Its Spartan simplicity and lasting strength insure constant, "care-free" operation. Nothing to get out of order . . . dependable. This compact unit installs right on the line without additional supports. Made for pressures up to 600 lbs. in sizes up to 4 in. For information, write:

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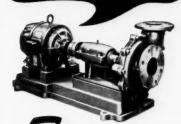


Representatives from Coast to Coast

#### HENSZEY BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers • Feed Water Meters
Flow Indicators • Proportioning Valves • Also MILK EVAPORATORS and PRE-HEATERS

# Custom-built for EFFICIENT DEPENDABLE SERVICE



## frederick SSV PUMPS

## Enclosed Impeller and Open Impeller Types

You're sure of maximum service and output with minimum maintenance or production down time with Frederick SSV Centrifugal Pumps because each pump is custom-made to fit your particular operation—whatever the consistency or type of liquid you're moving.

#### SSV PUMP FEATURES

- Pump sixes from 1" to 4" discharge openings.
- Pump capacities from 50 up to 700 U.S. GPM.
- Heads from 30 up to 220 feet.
- Pumps speeds can be varied to suit the driving media and operating conditions.

#### CONSTRUCTION ADVANTAGES

Pump casings are vertically split for easy accessibility. Mounted on a swivel to permit placing discharge in any desirable position. Pump openings, both suction and discharge, flanged to permit easier connection and disconnecting to joints. One-piece impellers, securely attached to shaft by stout key and lock nut, or threaded, give long service. Pump bearings mounted in sturdy frame horizontally split for easier accessibility. Extra long stuffing box provides for oversize stuffing. Mechanical seal also available for minimum leakage. Pump coupling flexible for direct connection to drivers or can be arranged for belt drive. Pump speed, pump openings, etc. are selected to suit your particular requirements.

Write for Bulletin No. 107



FREDERICK IRON AND STEEL, INC. FREDERICK Est. 1890 MARYLAND

### DENVER PROCESS EQUIPMENT

DENVER (patented) SUPER AGITATORS and MIXERS



3'x 3' to 20'x 20' Patented standpipe around propeller shaft assures positive agitation and circulation. Patented wearing plate prevents sand-up on shut-down. Heavy duty as well as acid-proof construction is available in both open-type, air lift and Super Agitator models. Please write for Bulletin No. A2-84.

DENVER Steel-Head BALL MILL



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A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trunnions. All-steel constraction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also available. Please write for Bulletin No. B2-B13.

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16" to 60"
Cutter
Travel

Heavy duty units, extra rigid track and balf-bearing wheels assure positive travel and timing of sample cutter. Available in stain-less steel for acid and corrosive service. Wet and dry cutters. Central Control Panel for multiple samplers. Bulletin. No. 51-84.

DENVER Forced-Feed JAW CRUSHER



21/4"x 31/2" pl to de 36"x 48" Se

Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy-duty, oversize roller- bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12.

DENVER Wet Reagent FEEDER



0 cc to 2000 cc Accurately moters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment to control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-By.

DENVER Disc FILTER



1 Disc, 2' to 12 Disc, 9' Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery. Also Drum and Pan Fillers. Please write for Bulletin No. FG-81.

DENVER "Sub-A" FLOTATION



Laboratory and Commercial

Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. Mare large plants are installing Denver "Sub-A's" for their entire flotation job, because they give maximum recovery at a law cost per ton. Dependable, low-cost, simplified continuous aperation. Please write for Bulletin No. F10-881.

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Concentration
TABLES



5 to 150 T/24 Hrs. A mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and a tilting device. It separates materials into bands and handles the coarsest sands with excellent results. Ideal for separation of groups of particles having a similar range of specific gravities. Write for Bulletin No. T1-B3.

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Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rod Mills, Classifiers, Agitators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tables, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial machines. Please write for Bulletia No. 1G3-B10.

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See Our New Catalog Starting on Page 647 CEC

FIRMS . . .

tibiotics and other pharmaceuticals, has capacity enough to supply needs of Chile and other nearby countries.

General Tire & Rubber Co. recently opened a new \$10-million copolymer unit at Odessa, Tex., capable of turning out 50,000 tons/yr, rubber.

Phillips Chemical Co. is in production at its new 180-million-lb./yr. ethylene plant at Sweeny, Tex. Part of production goes into Phillips' Marlex rigid polyethylene.

Stauffer Chemical Co. will swing into commercial production of Trithion, company's organic phosphate pesticide, prior to next crop season. Plans call for a multimillion-lb./yr. plant at Henderson, Nev.

Du Pont Co. has placed two domestic synthetic rubber plants on stream—Montague, Mich., neoprene plant has 50 million lb./yr. capacity, Hypalon plant at Beaumont, Tex., has 15 million lb./yr. capacity. A third neoprene plant is being erected in Londonderry, Northern Ireland.

Stillman Rubber Co.'s Extruded Products Div. has expanded into a new 10,000-sq.-ft. building alongside present facilities at Fullerton, Calif.; this completes a two-phase expansion program that boosted capacity 100%.

Union Carbide Corp. has awarded to Walsh Construction Co. the construction contract for its new office and laboratory facility near Tarrytown, N. Y. Buildings are scheduled for completion in summer of 1959.

Alberta West Forest Products is planning a \$25-million pulp and paper mill with a capacity of around 300 tons/day. Mill will be located in either Edmonton or Whitecourt areas of Alberta.

Callery Chemical Co. is adding a new ethylene unit at its high-energy fuel plant at Muskogee, Okla. Foster Wheeler Corp. is handling design and construction.

Ohio Chemical & Surgical Equipment Co., division of Air Reduction Co., has started production of nitrous oxide and cyclopropane at its two new Cleveland plants. Facilities, totalling \$1 million, have annual capacity of 240 million gal. of nitrous oxide and 9 million gal. of cyclopropane.

Sinclair Chemicals is starting production of high-purity propylene at Marcus Hook, Pa. Plant's output will be sold to Hercules Powder Co.'s plastic plant at Parlin, N. J.

Wyandotte Chemicals Corp. has acquired ten acres near Toronto, Ont., for future expansion of its Ford Division's line of cleaning products.

Aluminum Company of America is adding a seventh potline at its Point Comfort, Tex., plant. This 20,000-ton/yr. addition will up plant capacity to 140,000 tons/yr. when completed later this year.

California Ink Co. has formally opened its new two-story research center at Berkeley, Calif. The \$400,000 installation houses eight self-contained laboratories.

Canadian British Aluminum Co. has brought the first 45,000-ton/yr. unit of its new ingot smelter into production. Located at Baie Comeau, Que., plant's second production line is slated for completion in spring of 1959. Two later units will bring total capacity to 180,000 tons/yr. and total investment to \$200 million.

Eastern Stainless Steel Corp. has opened a district sales office in Cincinnati, Ohio, covering a five-state marketing area.

Shell Oil Co. is erecting a new laboratory at its Norco, La., refinery. The 30,000-sq.-ft. installation will be completed in early 1959.





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Technocheck is an exclusive valve principle developed and controlled by Techno Corp. It is employed in polyvinyl chloride and in a variety of metals as well.

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tile, tight sealing and operates on low pressure differential. Made in sizes from 1" to 8" with flanged or threaded ends. Write for Bulletin: Technocheck-PVC.





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Curiosity about QO tetrahydrofurfuryl alcohol (THFA®) can be rewarding in many different ways to those who investigate it.

Tetrahydrofurfuryl alcohol is the starting point for such interesting compounds as dihydropyran, pyridine, glutaric acid, 4-hydroxyvaleraldehyde, 5-(2-tetrahydrofuryl) hydantoin.

Solvent uses of THFA have attracted much attention. Its high boiling point coupled with complete miscibility with water makes it unique. Its solvency for resins, gums, dyes and complex organic compounds is excellent.

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### The Quaker Oals Company



CHEMICALS DEPARTMENT

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FIRMS . . .

Netherlands State Mines is erecting a 7,000-ton/yr. polyethylene plant, becomes first large-scale producer in Benelux countries. Plant will obtain ethylene from coke-oven gas and use I.C.I. high-pressure process.

Link-Belt Co. is opening a new district sales office in New Orleans.

Georgia-Pacific Corp. has opened a new wood-products research center at Hillsboro, Ore., will develop new applications for wood fibers.

Archer-Daniels-Midland Co. is building a new plant at Colony, Wyo., to supply bentonite for the iron industry. Bentonite, an adhesive clay, is used in pelleting iron ore powder extracted from taconite rock.

Texas Co. is building a deepwater pier at its new Anacortes, Wash., refinery, will handle world's largest crude tankers. Refinery will also feature a special water treating plant which will purify all waste water before disposal into Puget Sound.

Imeprial Oil Co.'s Ioco, B. C., refinery is undergoing a \$2.3-million expansion to meet increasing demand for oil products in British Columbia. Also under construction is a \$4-million catalytic reformer unit expected to be completed next spring.

Federal Telecommunication Laboratories has opened a 22,400-sq.-ft. laboratory at San Fernando, Calif., that will be used for basic research in communication problems.

Pittsburgh Plate Glass Co. is planning to build a multi-million-dollar, 350,000-sq.-ft. fiber glass yarn plant at Shelby, N. C. Unit will have 16 glass furnaces with total capacity of 25 million lb./yr. of yarn.

British Hydrocarbon Chemicals is building a high-density

polyethylene plant at Grangemouth, Scotland. Unit will use Phillips Petroleum's lowpressure process.

Diversey Corp. of Chicago has purchased a five-building insecticide plant in Waco, Tex. Diversey will manufacture industrial cleansing products, disinfectants and bactericides for Southwestern markets.

Scholven-Chemie, AG., W. German chemical manufacturer, will build a 6,000-ton/yr. polyethylene plant at Gelsenkirchen. Unit will produce low-pressure polyethylene from coke-oven gas via the Ziegler process.

Bay Refining Corp., whollyowned subsidiary of Dow Chemical Co., is upping refinery capacity to 15,000 bbl./ day with addition of a new topping unit for crude oil processing. Company is also adding a 3,500-bbl./day catalytic reformer at the Denver, Colo., refinery.

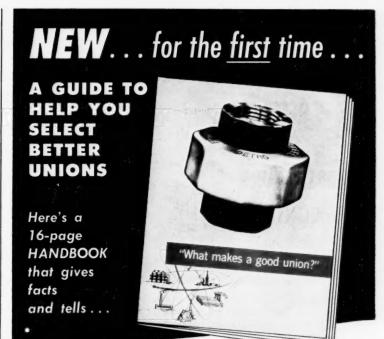
American Cyanamid Co. announces expansion of its Mobile, Ala., plant to include manufacturing facilities for wax sizes to supply the South's expanding paper industry.

Kerr-McGee Oil Industries has purchased a complete crude unit from Tidewater Oil Co. New unit, when installed at the Cushing, Okla., refinery, will have 23,000 bbl./day capacity.

Thermatomic Carbon Co. will double capacity of pelletedcarbon facilities at its Sterlington, La., plant when expansion program is completed early this year.

Carpenter Steel Co. has opened a new mill branch warehouse and office in Chicago which will also serve as midwestern headquarters for its Alloy Tube Div.

Armstrong Cork Co.'s research center at Lancaster, Pa., has added a new semiworks unit for conducting polymeriza-



# THE IMPORTANT THINGS YOU NEED TO KNOW ABOUT UNIONS

PRESSURE-TIGHTNESS comes when the seats are properly mated. "What Makes a Good Union" tells you how this is done.

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money-saving information contained in this easy-to-understand handbook.

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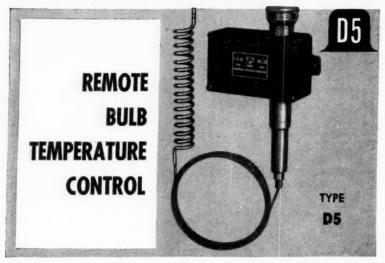
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#### MICROMETER-ADJUSTED



UNITED ELECTRIC's Type D5 Remote Bulb Temperature Control is a precision unit containing a micrometer adjustment for obtaining wide ranges and accurate temperature settings. This control has found extensive use in applications such as laboratory and industrial ovens, water baths, hot plates, etc.

Temperature Ranges	-150°F. to 200°F., 70°F. to 370°F., 100°F. to 650°F.					
Switch Ratings	15 amps. at 115 or 230 volts A.C. Also 20 amps. or D.C. switches on specification.					
Switch Types	N.O., N.C., or Double Throw — no neutral position.					
On-Off Differential	Approximately 1.0°F. or 2.0°F. dependent on model.					
Adjustment	Three-turn, calibrated knob rotated against graduated barrel. Readings and divisions equally spaced over entire range. Adjustment knob includes calibration screw.					
Electrical Connections	Made to internally located terminal block via clearance hole in the enclosure.					
Capillary Tube Length	Standard length six feet. Other lengths available.					
Enclosure	Die-cast aluminum case with black wrinkle finish. Other finishes available.					
Mounting	Control head surface mounted in any position by means of dog ears. May also be flush mounted.					

Complete information on the Type D5 appears in Section 200 of UNITED ELECTRIC's new catalog. Section 200 contains detailed data on UE's complete line of remote bulb temperature controls. This information is clearly stated and attractively illustrated. Send for your copy now.





FIRMS . . .

tion research on a substantial scale. Crawford & Russell handled construction.

Belfab Corp. of Agawam, Mass., manufacturer of welded metal bellows, is building a new plant at Daytona Beach, Fla., as first step in an expansion and decentralization program.

Centrico, Inc., Englewood, N. J. has added a new testing laboratory to investigate special industrial liquid separation problems.

Interchemical Corp. is consolidating its R-B-H Dispersions and Textile Colors divisions into a new Color and Chemicals Div. with headquarters at Hawthorne, N. J.



Champion Paper and Fibre Co., Hamilton, Ohio, has purchased half ownership of NRC Vaculite Corp. of Cambridge, Mass. The joint company will launch a major program to commercialize a new vacuum-metallized paper for packaging.

Penn-Mar Container Corp. has purchased Fibreboard Products, Inc., wholly-owned subsidiary of Fibreboard Paper Products Corp. Sale included two paperboard converting plants at Philadelphia and Baltimore.

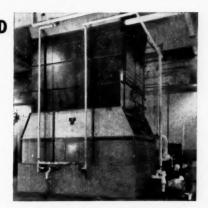
Witco Chemical Co. has acquired the stearate department of Sun Oil Co. Acquisition gives Witco production facilities for metallic stearates in four separate locations in the U.S. and one in Canada.

Vulcan Materials Co. has merged Union Chemical & Materials Corp. of Chicago and Lambert Bros. of Knoxville, Tenn., into Vulcan and has acquired seven other cor-

## WHEREVER YOU NEED TO COOL A FLUID... and have a problem of water supply or disposal . . . use NIAGARA "AERO" HEAT EXCHANGER

▶ Evaporating a very small amount of water in an air stream you can cool liquids, gases or vapors with atmospheric air, removing heat at the rate of input, controlling temperature precisely. Save 95% of the cost of cooling water; save piping, pumping and power. You quickly recover your equipment cost.

You can cool and hold accurately the temperature of all fluids, condense



vapors, cool water, oils, solutions, intermediates, coolants for mechanical. electrical or thermal processes. You have a closed system free from dirt. You have solved all problems of water availability, quality or disposal, maintenance expense is low.

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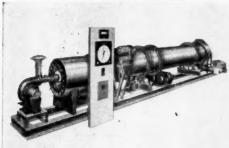
For more information, write for Bulletins 120, 124, 135. Address Dept.

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#### 2' 3" Diameter x 16' long DAVENPORT ROTARY FLASH FIRED DRYER





#### **DRYING ASBESTOS**

The above photograph shows a 2'-3" x 16'-0" DAVEN-PORT Rotary Flash Dryer for drying asbestos. This is a package unit fired with natural gas, with complete automatic controls. Furnace output 1,250,000 B.T.U.

Let our engineers consult with you on your Pressing, Drying and Cooling problems or send for our catalog "A". For quick reference consult your Chemical Engineering Catalog.



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Just Published. Gives answers to both routine and specialized questions regarding the choice of engineering materials. siders materials from the viewpoint of engineering structures, machinery, and equipment, and includes technical tables, design information, structural characteris-tics, etc. Emphasis is placed on the fabricated forms of materials, their physical and mechanical properties, adaptations, advantages, limitations, comparison with each other, wear resistance, and other facts of design importance. Pre-

pared by a staff of specialists. Edited by Charles L. Mantell, Consulting Engr.; Newark College of Engrg. 1906 pp., 648 illus.,



### INTRODUCTION HEAT TRANSFER

New 3rd Edition, Just Published. Shows how to solve heat transfer problems in the fields of aeronautics, chemical, electrical, and mechanical engineering. Covers heat transfer fundamentals, applying calculations to design of feed-water heaters, condensers, boilers, internal-combustion engine cylinders, and fan coils. Takes up radiation-forced convection-heat transfer to boiling liquids—condensing vapors—variable heat flow, etc. By Aubrey I. Brown and Salvatore M. Marco, Dept. of Mech. Engrg Ohio State U. 3rd Ed. 328 pp., 70 illus., \$6.75

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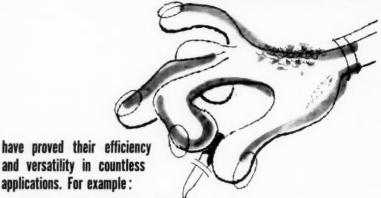
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625,000 lb

sodium bromide crystallization solution

250,000 lb

molasses, vat dye solution, trioxide pickling solution, tall oil

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NAME		262 My foamer is
TITLE		Oil system
COMPANY		Food products
CITY	ZONE STATE	

FIRMS . . .

porations. The mergers and acquisitions expand Vulcan's services.

American Air Filter Co., Louisville, Ky., is planning to acquire the stock of Kennard Corp. of St. Louis, Mo. If transaction goes through, Kennard, maker of heating and cooling equipment, will be operated as a whollyowned subsidiary of American Air Filter.

Texas International Sulphur Co. has acquired all equipment and assets of Standard Sulphur Co. Acquisition helps Texas Sulphur in building Frasch process sulfur plant at Texistepec, Mexico.



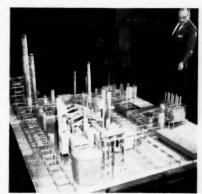
Aluminum Tubing Co., Jacksonville, Fla., has changed its name to Roll-Weld Pipe and Tube, Inc.

Cyanamid International is the name of the new division now handling all international operations for American Cyanamid.



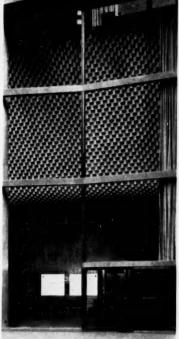
Western Precipitation Corp. has appointed Process and Power, Inc., as sales agent for Multiclone centrifugal collectors and Dualaire jet-cleaned filters.

Milton Roy Co. has four new engineering representatives: Brosey and Frew, Inc., Indianapolis, Ind.; Bernhard Engineering Sales Co., Dallas, Tex.; Tate Engineering, Richmond, Va.; Jay Instrument and Specialty Co., Louisville, Ky.



200,000,000 lb. per year ethylene plant

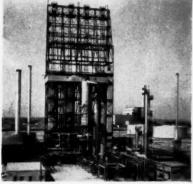
High pressure acetylene chemicals plant



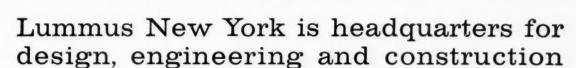
The Lummus Company headquarters 385 Madison Avenue, New York, N. Y.



Bervllium plan



600 ton per day coking unit



Engineers and Constructors of More Than 700 Refineries, Chemical and Petrochemical Plants of all Types and Sizes Throughout the World in the Last 50 years.

The Lummus Company headquarters are at the business crossroads of the world in New York, ready to coordinate the engineering skills of over 3,000 permanent employees located in seven branch offices and subsidiaries throughout the world.

A staff of more than 1,000 scientists, engineers and administrators contributes a wealth of skill and experience — each in his chosen field—to handle the great mass of detail involved in a modern processing plant. Few single companies in the process industries can afford to maintain the reserve of industrial experience and engineering skill that characterizes the Lummus organization.

In addition, Lummus maintains a 150,000 square foot Engineering Development Center in Newark, N. J., to bridge the practical gap between laboratory research findings and commercial plant operation. The Center has extensive pilot plant facilities in operation, and is equipped for designing and building new units.

Several recent domestic projects of The Lummus Company (pictured above) are: a 200,000,000 lb. per year ethylene plant; the world's first full scale, high-pressure acetylene chemicals plant; a beryllium metal plant; and a 600 ton per day coking unit designed for the heaviest charge ever fed to a coker.

See Lummus on your next project.

Branch offices of The Lummus Company are located at Washington, D. C.; Chicago; Houston, and Baton Rouge.

Subsidiaries are in Montreal, Caracas, London, Paris, The Hague and Bombay.



ENGINEERS AND CONSTRUCTORS FOR INDUSTRY 385 MADISON AVENUE, NEW YORK 17, N.Y.

## **AL Stainless Steels** for the Process Industries

VARIOUS TYPES—Generally speaking, stainless steels are divided into three groups: chromium, chromium nickel, and chromium-manganese-low nickel steels. Their corrosion resistance, hardenability, tensile strength, etc., varies with the proportion of chromium, nickel and other alloying elements each type contains.

The chromium stainless grades are divided into two types: martensitic steels, which are hardenable; and ferritic non-hardenable steels. Both types are magnetic. The chromium nickel and chromium-manganese-low nickel stainless grades are austenitic steels, hardenable only by coldworking, and

are non-magnetic.

The principal chromium stainless steels of chemical industry significance are Types 410, 431 and 440A martensitic grades, and Types 405, 430, 442 and 446 ferritic steels. Chromium nickel austenitic steels of principal importance are Types 302, 304, 316, 317, 347, 309 and 310. In the more recently developed chromium-manganese-low nickel austenitic group, Type 202 has physical and mechanical properties closely approximating those of Type 302-with the advantage of much lower nickel content and more ready availability in times of nickel shortage.

PRINCIPAL GRADES-Industry has called for quite an extensive range of chemical and physical properties in stainless steels. To meet these require-ments, types have been developed which are best suited for a particular application: such as Types 316 and 317 for extra corrosion resistance, Types 309 and 310 for extra high temperature service, etc. Knowledge of these stainless steel qualities is essential for engineers and designers to create a product that will best do the work for which it was intended. Complete data on AL Stainless Steels is available in the various publications listed below. · Of all the stainless steels, the grades most used in the chemical and allied industries are Types 304, 316, 317 and 347 chromium nickel steels. The first three grades are also available in extra low carbon varieties to meet extreme conditions of fabrication or service which might carry the threat of intergranular corrosion. Designated Types 304L, 316L and 317L, these low carbon stainless steels are practically immune to carbide precipitation in the aswelded condition. Like Type 347, they

permit the field-welding and stressrelieving of material of any thickness, for example, without the hazard of intergranular corrosion.

REGULARLY SUPPLIED FORMS

-Allegheny Ludlum Steel Corporation is in position to furnish the various grades of stainless steel in all of the commercial forms required by fabricators of these metals. These include:

· Plates, including formed heads

- · Sheets, either coiled or straight cut lengths Strip, either coiled or straight cut lengths
   Bars, rounds . . . flats . . . hexagons . . .
- octagons . . . squares or special shapes

   Billets, for forging or upsetting

Angles

• Wire

- Tubing, seamless or welded · Castings and smooth-hammered Forgings
- Extrusions
- Clad stainless

Information as to size ranges and mill tolerances are available in literature devoted to detailed discussions of AL Stainless Steels.

SPECIAL REQUIREMENTS—When selecting a grade of corrosion and heat resisting steel for a given application, it should always be borne in mind that laboratory tests, however carefully performed, can be expected at best to be only indicative of field performance. Variations in actual service conditions are so wide that a special study of the case at hand may be necessary at times. To that end, Allegheny Ludlum engineers and technical men are available for consultation on unusual problems involving stainless applications.

FABRICATION—AL Stainless Steels may be easily fabricated by any of the usual processes-welding, drawing, blanking, machining, spinning, forging, riveting, shearing, soldering, etc. In some instances, however, care must be exercised in handling of the material to preserve its corrosion or heat resisting properties. No one should undertake to fabricate any of the stainless steels without a full understanding of these handling procedures. Proper

processing is fully discussed in Allegheny Ludlum literature-available on request.

RESISTANCE TO ATTACK—There is a wide range of conditions under which AL Stainless Steels operate in resisting corrosive attack at normal and elevated temperatures. Detailed information regarding their resistance to various media, heat resistance and strength will be sent upon request. See the publication list below.

STAINLESS CLAD STEEL—Allegheny Ludlum Stainless Clad is available commercially in the following commodi-

- · Double Clad-Stainless both surfaces with carbon steel core. In plates, sheets and
- Single Clad-Stainless one side only; plates only 3/16" and heavier.

Special clad materials on application.

#### **PUBLICATIONS AVAILABLE —**

The following list of technical and service literature is freely available on request; just ask for the bulletins which contain the type of information you need.

Blue Sheets - An individual Blue Sheet, containing certified laboratory data on physical and chemical properties, etc. is available on each grade of AL Stainless Steel.

Fabrication of Stainless Steels—Contains valuable data for your shop men on various methods of handling, forming and finishing stainless steel.

AL Stainless Steel in Chemical Processing-36 pages on various applica-tions, advantages, etc. of stainless in the chemical industry.

Stainless Steel Handbook—A case. bound book of 124 pages, containing complete data leading to the proper selection and fabrication, etc. of the correct grade of stainless for each application.

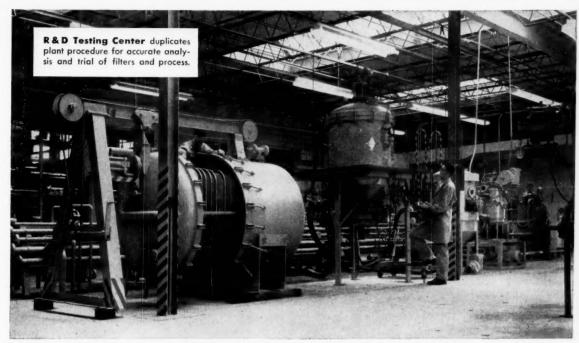
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## New Research Center analyzes filtration under full-scale process conditions

Industrial's Research and Development Division helps you select filters and study processes without disturbing production in your own plant.

Maximum efficiency in filtration can only be gained by examining filters and the process in actual operation.

To do this, Industrial can place at your disposal \$250,000 worth of equipment and a staff of chemists, engineers and physicists experienced in the problems of liquid-solid separation.

The Testing Center includes all types of pressure filters, batch and slurry tanks, heating and cooling systems, chemical addition systems, and various pumps... all interconnected with an ingenious valve and piping system. Any conceivable process condition can be duplicated at Industrial. Fluids can be routed from batch or slurry tanks to any filter to test its effectiveness, operating efficiency, and make rapid comparisons of filter types. The process itself can be studied thoroughly and comparative data on variations is obtained in minutes instead of days of costly experimentation in your plant.

Industrial builds filters for your processes with the same scientific approach and practical engineering skills that produced this advanced analytical center.

Talking to an Industrial field engineer will put you in touch with the most capable staff and research facilities available today. Bring your filtration problems to Industrial. We will be glad to make analyses and recommendations.



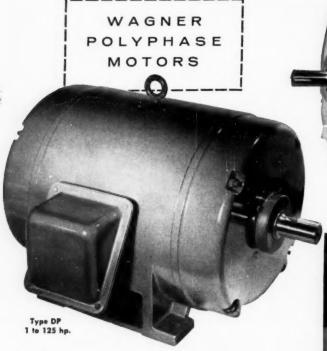
R & D Chemical Laboratory checks and maintains quality control of influent and provides precise analyses of effluent during testing and research operations.



R&D Physical Lab....analyzes densities, viscosifies and other physical properties of process fluids . . . enables engineers to check filters and make pilot runs under simulated conditions.

INDUSTRIAL

INDUSTRIAL FILTER & PUMP MFG. CO.
5918 OGDEN AVENUE . CHICAGO 50, ILLINOIS



# These open type motors give DOUBLE PROTECTION... can be used in many places that formerly required splashproof motors

Wagner Type DP Motors offer the *double protection* of rugged corrosion-resistant cast iron frames and dripproof enclosures so well designed that the DP Motor can handle many applications that formerly required splashproof motors.

These Wagner Motors are built in the new NEMA ratings that pack more power into less space, are lighter in weight and are easier to maintain—only occasional lubrication is required.

#### SLEEVE BEARING MODELS AVAILABLE

The entire line of ratings through 125 hp. is available with steel-backed, babbitt lined sleeve bearings that have high carrying capacity and provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

1 to 125 HP-1750 RPM-40°C NEMA FRAMES 182 through 445U

Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

WM58-

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES'



**DOUBLY PROTECTED** — Wagner DP Motors offer the double protection of completely dripproof enclosures and rugged cast iron frames that can take rough handling and resist corrosion.

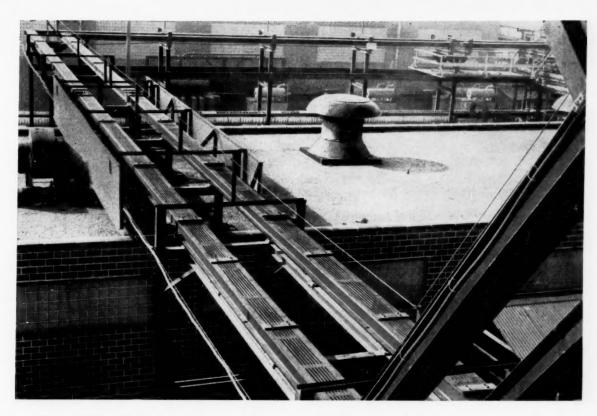


CAN BE RELUBRICATED — These motors can be re-greased when desired for longer bearing life. Fresh grease can be added—old grease removed—through openings provided in the ball bearing housing.



**COOL RUNNING** — Specially designed baffles direct cooling air through the motor to protect the stator windings. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

February 10, 1958—CHEMICAL ENGINEERING





- ▲ Insulators are installed at bottom and sides to support the bus and brace against short circuit forces.
- ◀ Sloping aluminum bus is unsupported between buildings of different heights. Steel frames provide rigidity.

# Alcoa Aluminum Bus Serving Ethyl's Sodium-Chlorine Plant

To transmit 30,000 dc amperes at 550 volts from one rectifier station to another, at a circuit distance of 700 feet, Ethyl Corporation engineers weighed the facts, then chose lightweight, corrosion-resistant aluminum bus conductors. In considering conductors, they found three big advantages with aluminum: it cost less per foot of conductor; weighed about 50% less than copper of the same current-carrying capacity; and, as a result of this lighter weight, also reduced the cost of supporting structures for the system.

This is the second aluminum bus conductor installation by Ethyl. The performance of the first, as well as its economy, led to this second installation. The bus system serves sodium-chlorine electrolytic cells. The natural oxide film on the aluminum protects the bus from further corrosion. This protective film also improves the heat-radiating characteristics of the bus, permitting cooler operation or additional load-carrying capacity.

Savings also appeared during installation. Shielded arc consumable electrode welding, because of its flexibility and

speed, was used for the welded joints. Most of the welding was done on the ground where the supporting beams were assembled, facilitating installation and increased safety.

As in many industries, the electrochemical industry has found that bus systems of Alcoa® Aluminum are the modern answer to the need for economical power distribution. For complete information about Alcoa Bus Conductors, consult your local Alcoa distributor or sales office, or write to Aluminum Company of America, 2304-B Alcoa Building, Pittsburgh 19, Pennsylvania.



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## Which is the best way to compress gas?



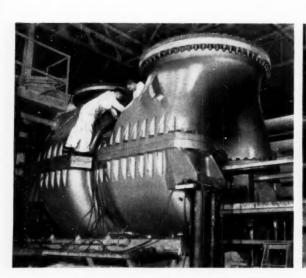
That depends. The compressor that's right for small volume flow isn't right for large volume flow—and vice versa. With the widest selection of compressors in the field, Carrier has the right unit for your process. Equally important, with greater experience handling more different gases in its compressors than any other manufacturer, Carrier offers application skill unmatched in the industry. Shown below are a Carrier Centrifugal Compressor for small volume flow and an Axial Flow Compressor for large volume flow. For complete information about them, call your nearest Carrier office.

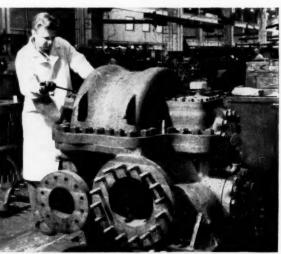
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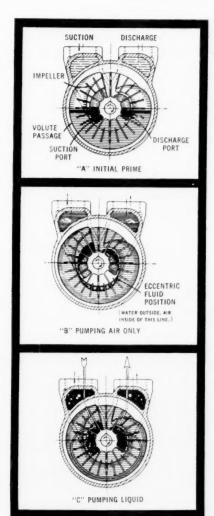
For large volume flow beginning at 75,000 cfm, Carrier Axial Flow Compressors are the answer. This unit, rated at 276,000 cfm, was made for use in a butadiene plant in the southwest. Carrier Axial Flow Compressors offer distinct advantages for large volume flow. Their high efficiency effects a significant reduction in operating costs. And their dependability is proved—the hundreds now in use have given reliable service for a total of over 60 million operating hours. Frame sizes are rated up to 600,000 cfm when operating on air.

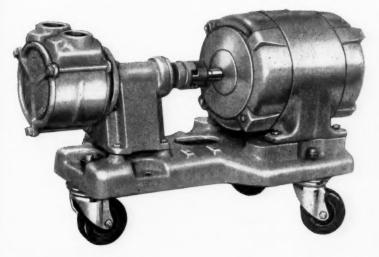


For small volume flow starting at 1000 cfm, Carrier Centrifugal Compressors are the answer. This unit, the smallest in the Carrier centrifugal line, is installed in a refinery in Texas. Carrier has manufactured compressors that withstand pressures up to 2400 pounds, are driven with drivers of over 10,000 hp and attain extremely low temperatures. Their ability to run 24 hours a day, 7 days a week, year in and year out, is a matter of record, demonstrated in chemical, petrochemical and refinery processes in plants throughout the world.

# NOW there's a <u>better</u> pump for the toughest transfer service

Goulds new self-priming Liquid Ring Pump pumps liquid... pumps air... pumps liquid and air





Now you can get quick and continuous self-priming with a pump that handles any combination of air and liquid.

This unique new Goulds pump puts *centripetal* action to work to eliminate manual priming and air binding. Even with loops or leaks in your suction line its high air handling capacity keeps the liquid moving.

The pump's impeller and a volute casing achieve the self-priming. The impeller forces liquids along the volute, building up pressure as the liquid moves to the narrow end. This pressure sets up a liquid piston action between each set of blades, forcing liquids to the center of the pump. The liquid piston forces any air entrapped in the center up through the outlet.

The Goulds Fig. 2520 pump is available in all-iron construction, or in stainless steel for corrosive service. Offered as a mobile unit (as illustrated), pump-motor unit, or pump only for V-belt drive. With 1½ inch suction and discharge, the pump itself weighs 42 pounds. Capacities to 60 GPM, heads to 80 ft.

There's a complete description of the pump in Bulletin 725.6. Write for a copy or contact your Goulds representative.

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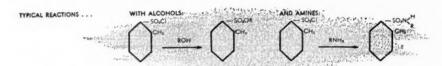
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# Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.



# **Producing Crystal-Clear Brine at** Lowest Cost—by Self-Filtration

Today, more and more companies are using a foolproof brine-making process that produces crystal-clear brine from rock salt, without using supplemental filter beds or other filtering devices. This process takes place in the "Sterling Lixator," a rock-salt dissolver developed exclusively by International Salt Company. Operating on International's principle of selffiltration, the Lixator produces a rocksalt brine so high in purity and so brilliantly clean and clear that it can be used in many operations formerly thought to require highly refined evaporated salt.

Here, briefly, is how self-filtration works in the Sterling Lixator: A Lixator is filled with Sterling Rock Salt. Water, admitted near the top, dissolves salt as it flows downward. While flowing down, the brine made in this way becomes fully saturated, and can dissolve no more salt. Still flowing down, this brine is completely filtered by the salt-crystal bed in the bottom portion of the Lixator. Thus, the Lixate Brine drawn off through a discharge pipe at the bottom of the Lixator is clean, pure, crystal-clear-and the only source of power used is gravity, which costs nothing!

Other Lixator advantages. In addition to this superbly clean, fully saturated Lixate Brine, a number of other advantages are yours, when you use a Lixator:

- The Lixator permits salt storage and brine making at one location most convenient to the point of salt entry. Pipes deliver brine to points of use.
- Because Lixate Brine is piped to points of use, the work of moving dry salt from storage piles to other plant locations is eliminated. This can produce substantial savings in labor.
- The Lixator automatically controls salt feed, water feed, and brine discharge. Rapid, uniform brine production is maintained constantly, because in the Lixator there is no bridging, caking, or channeling.

BULK ROCK SALT SHIPMENTS UNLOADED DIRECTLY INTO STORAGE TYPE LIXATOR STERLING **ROCK SALT** B STORAGE TYPE LIXATOR A. SALT STORAGE ZONE

- B. SALT DISSOLUTION ZONE C. BRINE FILTRATION ZONE
- D. WATER INLET
- E. BRINE OUTLET

The Storage Lixator — designed for larger operations. This is a combination salt storage tank and dissolving tank. On delivery, rock salt is unloaded directly into the Storage Lixator. The rest is automatic.

Many types of Lixators are available from International Salt Company. In addition to Storage Lixators, there are Silo Lixators and Sterling Model Lixators-in numerous designs to suit any plant layout. And every Lixator operates on the economical self-filtration principle.

For expert advice on the particular Lixator type that will do the best job for you, phone or write the nearest district sales office, or write to us direct. One of our sales engineers will gladly show you how this remarkable brine-making equipment can help you use salt most efficiently and economically.

Using salt efficiently in its many industrial applications calls for technical knowledge and experience. International Salt Company has both. Plus a continuing program of research and development in salt. These things can be put to work for you, in your plant, to help you get the most out of the salt or brine you use.

INTERNATIONAL SALT CO., SCRANTON, PA.

Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Rich-

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If ever a compliment could cut the ground out from under a man — you just read it. Just make sure your management never says it about you.

Once upon a time, business moved at a slower pace, and people and things were sort of tidily pigeonholed. So many companies were wedded to a single product, a modest plant, simple processing, comfortable competition, family ownership and one-man rule.

Once upon a time, you could be a specialist in a particular part of a particular business, live within narrow walls, and everything was just dandy. No longer! Today, job isolation is stagnation. Companies, products, industries, have cross-bred like crazy. Anybody's business is everybody's business. Being "an expert" is always essential in depth, lacks much in breadth.

Look ahead, read ahead, get ahead. Open up this magazine, and start reading as you never have before. In the past, your eye instinctively has spotted the pages concerned with you and your job, and you've read this material and used it. Now, take the next big step. Read the stories involving other job functions,

other men's brand of problems in your field. Get on speaking acquaintance with all the phases and facets of your business—what one McGraw-Hill publisher so aptly calls "Cross-Communication."

You see — you, yourself, are really two men . . . one well-versed in your specialty . . . the other, well-informed on "the big picture". And this same one McGraw-Hill publication is edited to satisfy both of you. How well? Read on, and be pleasantly and profitably surprised.

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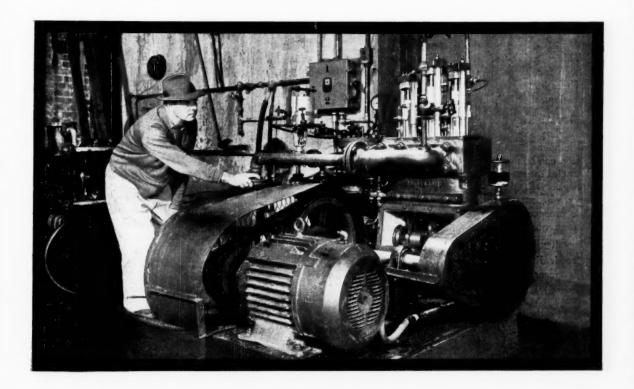
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Precise, non-fluctuating pressures must be maintained in continuous processes at the Carlstadt plant of Jacques Wolf & Company. Erratic pressure caused by drop in volumetric efficiency could ruin an entire batch of costly material.



How Jacques Wolf solved the puzzle: Looking for an answer to the problem of holding constant pressure, plus that of increasing production, Jacques Wolf called on Aldrich. Aldrich engineers designed a pump which provided the proper corrosion resistance, fluid velocity and wear characteristics to insure dependable, continuous operation.

Result: After five months of use, the Aldrich Triplex Pump has met all guarantees and proven itself capable of continuous operation. Working 24 hour days, 6 day weeks, the Aldrich Triplex Pump provides the necessary pressure without fluctuation, efficiently handling both alkaline and acidic materials.

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# Pay Of College Teachers . . . Where The Russians Are The Capitalists

This editorial deals with a simple question about college faculty salaries: Which country pays its teachers better, Russia or the United States? It's a good question, with a sadly embarrassing answer.

That American college and university teachers are underpaid is not a novel observation. But what has happened to the economic status of their profession can be put in more candid terms. As far as financial incentives are concerned, we have virtually socialized the academic profession. Teaching has become such a poorly paid career, with so little prospect of material reward for outstanding performance, that it simply does not attract enough highly qualified young men and women.

Ironically, the Soviet Union has deliberately and successfully used capitalist incentives to improve its educational system. Although the Russians show an utter disregard of civil liberties, they pay their teachers well and confer on them all the prestige and privileges the Soviet society can offer. Russian professors, together with party officials and scientists, have become the privileged upper class of a supposedly classless society.

#### Incentives To Be A Teacher

To be a college teacher requires high intellectual competence and long, sometimes costly, formal training. Aside from the appeal of academic life, what incentive does college teaching offer bright young men and women?

In the U. S., the average faculty salary is little more than the average income of industrial workers. According to the National Education Association, the average faculty salary is about \$5,240. College instructors receive \$4,100, associate professors \$5,730 and full professors \$7,100.

The average income of U. S. factory workers in 1956 was \$4,530.

Actually, workers in many industries — steel, automobile and petroleum, for example—earn more on the average than college teachers. And skilled workers often earn more than full professors at some of our colleges and universities.

In Russia, on the other hand, the young Soviet graduate can see that it pays — and pays very well — to choose teaching as a career. The head of a department in a Russian university can command a salary of about 6,000 rubles a month.\* This is about eight times the income of the average Russian worker, who earns 750 rubles a month.

The Russian professor comes off very well in terms of what his income will buy. It has been estimated that, based on Soviet consumption patterns, 6,000 rubles a month is worth about \$7,200 a year — or higher than the average professor's salary in the U. S. Of course, it is difficult to compare living standards in two countries as different as the U. S. and Russia. But particularly in the field of science — where the salaries can run to 15,000 or more rubles a month — it is clear that the Soviet professor enjoys a higher real income than that offered his American counterpart by a much more prosperous economy.

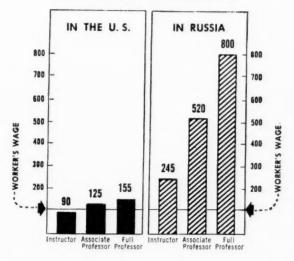
#### Incentives To Be A GOOD Teacher

Russia also offers much higher premiums than the U. S. to those who attain distinction in teaching. Teachers at the university level earn significantly more than teachers in high schools, and university instructors can look forward to a sharply progressive rise in earning power as they

Soviet Education for Science and Technology by Alexander Korol of the M.I.T. Center for International Studies.

#### How Faculty Salaries Compare With Industrial Wages

(Worker's Wage In Each Country = 100)



\*Sources: Center for International Studies, M.I.T.; National Education Association; McGraw-Hill Department of Economics

advance to higher positions. The spread between the income of a full professor and the lowest academic position is greater than fifteen to one. In addition, full professors can earn a healthy bonus if they are elected to membership in the Russian Academy of Sciences.

In the U. S., by contrast, full professors on the average earn less than twice as much as beginning instructors. And many college professors earn less than public school teachers in large cities. Even a full professor's pay does not compare with earnings in other professions or in positions in industry requiring similar training. The point was well summarized in a recent speech by Marion B. Folsom, Secretary of Health, Education and Welfare: "It is nothing short of a national disgrace that we are discouraging people who want to teach by offering salaries that are far below the levels justified by their training and far below the levels which others are willing to pay."

Our colleges and universities, as well as our teachers, find themselves in a serious predicament. Faced with a shortage of both funds and teachers, they cannot reward distinguished performances. Limited resources for salary increases have gone predominantly to the lower ranks, so that an adequate number of teachers could be retained. Meanwhile, potentially fine teachers are being siphoned off into better paid occupations.

The shabby treatment of our teachers threat-

standards, but our free enterprise system itself.

There is the recent example of a liberal arts college which discovered that five of its graduating seniors were being offered starting salaries higher than those paid any of their professors. It would be surprising if experiences like this did not place a strain on the enthusiasm with which these professors deal with some key aspects of American capitalism.

Also important is the role education is playing in the cold war with the Soviet Union. The Russians have made great strides in raising the quality of their education -- particularly in science and engineering. Both the number and the technical calibre of their graduates are impressive, as recent Soviet achievements testify. These successes owe much to the generous economic treatment the Russians have given their teaching profession.

#### A Standard For Faculty Pay

Earlier editorials in this series have outlined various ways American business can help relieve the financial plight of our colleges and universities. They have suggested that private contributions to higher education should average at least \$400 million a year over the next ten years if faculty salaries are to be raised to adequate levels and our colleges are to be able to meet increasing operating costs.

Another standard for raising faculty salaries proposed by an American businessman is this: "When a teacher's income gets up to a point where you will suggest to your boy that he ought to give some thought to teaching as a profession, then we may be approaching the right figure."

Russia clearly has set her teaching salaries well above the "right" figure. We are nowhere near it. What this adds up to is that the Communists — not we — have become the shrewd capitalists in the vital field of education.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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# Reader Service Cards Are Your

USE YOUR PENCIL WHILE YOU READ. MORE INFORMATION

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items. And to locate an ad; T (top), B (bottom), R (right), L (left). The index below is a guide for advertising pages showing more than one item.

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# **Key to Tomorrow's Problems**

#### ON EQUIPMENT AND PRODUCTS IS YOURS FOR THE ASKING

COMPLETE PRODUCT INDEX of chemicals, materials, equipment and services taken from this issue's advertisements and new products depart-

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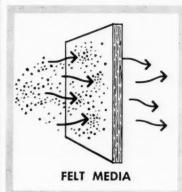
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# DAY

#### DUST CONTROL NEWS





#### Here's why felt filter media traps dust BETTER!

This magnified view of filter media makes it easy to see why felt is more efficient than woven cloth. With cloth, the average opening between thread strands is above 10 microns. Felt, however, is made up of closely matted fibres and the air travels a tortuous path between the thousands of individual fibres. For all practical purposes, the resistance of these media is the same. That's why felt filtering media (wool or synthetic) is used exclusively in all filters made by DAY.

Consider this important fact. What happens when these two media are cleaned? Woven cloth is cleaned by shaking, rapping or low velocity reverse air. In many cases woven cloth is overcleaned, permitting leakage until openings between strands are again plugged with dust. The overall performance is one of erratic back pressure and filtering efficiency. With DAY filters the porosity of the felt media is maintained by automatic counter flow air. Back pressure doesn't vary and peak filtering efficiency is constantly maintained.



Whether your problem is collecting and recovering valuable dust or controlling dangerous or obnoxious dust; write for our free bulletin "DUST FILTER FACTS." Read this bulletin carefully before you decide on any dust filter. It contains useful charts and air engineering data. It also contains more information about the many services and equipment available from DAY. Write toDAY for Bulletin F-75.

## The DAY Company

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# **Bulk or Fabricated Parts**



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Whenever you call or write for information on prices, availabilities or service, you get a prompt reply.



#### DELIVERIES ARE MADE ON TIME-

Orders for the most frequently used types of wire cloth are promptly filled. If we can't supply what you want from our complete stock, we'll schedule our looms to get it to you as soon as possible.



#### INSTALLATIONS ARE CHECKED-At

Cambridge, orders aren't filled and forgotten. Our own sales engineers follow up your order to make sure our product is giving you the best possible service.

QUALITY, OF COURSE-Individual loom operation and countless checks on mesh size and mesh count assure you of highest quality wire cloth when you specify Cambridge.

Let us quote on your bulk or fabricated wire cloth needs. Samples for inspection or test purposes are available upon request. Call your Cambridge FIELD ENGINEER. He's listed in the phone book under "Wire Cloth." Or, write direct for FREE 94-PAGE CATALOG and stock list giving full range of wire cloth available. Describes fabrication facilities and gives useful metallurgical data.



#### The Cambridge Wire Cloth Co.

BELTS

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Department G, Cambridge 2, Maryland

IN PRINCIPAL INDUSTRIAL CITIES



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# TECHNICAL LITERATURE

EDITED BY N. J. DEGENHARDT

- Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide—free—just for the asking.
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#### Chemicals

# Acid, Peracetic.....48 p. booklet includes treatise on peracetic acid, reactions of epoxides. Also lists properties and possible uses of 12 epoxides now available in research samples. Booklet F-40, 108. 225A Union Carbide Chemicals Co.

- Alcohol, Tetrahydrofurfuryl . . . . . QO
  tetrahydrofurfuryl alcohol is readily available, safe to handle and
  now lower in cost. Bulletin 206 gives
  physical data, chemistry, uses and
  general information.
  200 \*Quaker Oats Co.
- Electrochemicals.....16 p. booklet,
  "Gifts of the Firebird," describes
  23 products of the high temperature electric furnace. Includes information on silicon carbide, zirconium oxide and carbide, boron.
  225B Norton Co.
- Organic Chemicals.....1958 physical properties booklet lists more than 400 synthetic organic chemicals produced by Union Carbide. Included are 50 new chemicals available for product development. 225C Union Carbide Chemicals Co.
- Rare Earths.....Rare earths in purities up to 99.99% are now commercially available for use on a production basis. Company offers detailed information in "Purified Rare Earth and Yttrium Oxides". 58 \*Lindsay Chemical Co.
- Refractories . . . . "Norton Refractory Grain" is a valuable reference book that tells you about the chemical and physical characteristics of Crystolon, Alundum, and other refractory materials.
- Resins.....12 p. brochure includes property data on line of coumarone-indene resins, modified styrene resins, plasticizers. Charts show physical and chemical data, compatibilities, solubilities. 225D Penna. Industrial Chemical.
- Solvents, Aromatic.....Shell aromatic solvents for industrial finish formulation cover a very wide evaporation range, satisfying requirements in a variety of formulations. Request Booklet.

  \*Shell Oil Co.

• From advertisement, this issue

#### **Construction Materials**

Alloys, Nickel-Base.....Hastelloy alloys are nickel-base materials with unusual resistance to hot mineral acids, strongly oxidizing salts and powerful gaseous oxidants. New Booklet available.

155 \*\*Haynes Stellite Co.

Coatings, Ceramic . . . . Extremely hard, chemically inert ceramic coatings applied to shafts and shaft sleeves eliminate the costly failure of "chewed up" shafts and sleeves. Bulletin CP28.

L229 \*Chemical & Power Products.

Fabrication.....For process equipment or complete pilot plants, Artisan offers complete service, superior manufacturing ability, economy and on-time delivery. Request informative folder now. 59 \*Artisan Metal Products.

Fiber.....Bulletin gives general information about versatile Dynel fiber. Industrial uses include air filters, chemical-resistant clothing, furnace filters, overlays for reinforced plastics.

225E Union Carbide Chem. Co.

Linings, Teflon.....Cementable Teflon with one side treated for application to metal, wood, glass, concrete or other surface with standard adhesives is available in tapes and sheets, Bul. AD-158.

183

\*U. S. Gasket Co.

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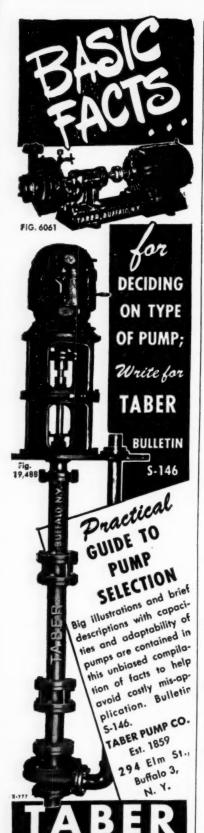
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Malvern, Pennsylvania



LITERATURE . . .

terials, Rubber & Plastic.....
Piping, pumps, valves and tanks are made of eleven job-proved rubber and plastic materials. Wide range of temperatures, pressure, impact resistance. Bulletin CE-50.

174a \*Amer. Hard Rubber Co. Materials,

Metals, Non-Ferrous.....Tabbed, 60 p. copper and brass warehouse stock list includes all items and sizes carred in stock for immediate shipment from American Brass Co.'s warehouses arehouses. American Brass Co.

Polyvinyl Chloride.....Light, tough polyvinyl chloride withstands 281 corrosive chemicals. Available as pipe valves, fittings, sheets and bars. Nontoxic, flame-resistant. Bulpars, 1903-3. letin 80-3. 124 \*Joseph T. Ryerson & Son.

els, Stainless.....Company offers Blue Sheets on each grade of stainless steel, bulletin on fabrication, one on stainless steel in chemical processing, and Stainless Steel processing, Handbook. 206 \*Allegheny-Ludlum Steel Corp.

ide Metal.....Talide metal, a tungsten carbide, is harder, stronger and more resistant to abrasion than any other metal. For applications subject to wear, heat, strain, shock. Cat. 56-G. \*Metal Carbides Corp. 30

on.....Company supplies Teflon in sheet, rod and tube forms, in a wide variety of sizes. Material is non-porous, chemically inert, strong and flexible. Request bulletin, "The Best in Teflon". 176 °Crane Packing Co.

#### Electrical & Mechanical

Chain Drives.....Book 2425 contains 88 p. of engineering data and illustrations of silent chain drives. Includes tables of service factors, ratings, chain length and center distance computation.

226B Link-Belt Co.

Couplings..... A Kamlok quick coupler slips on, the cam tightens, it holds tight and never fails. In bronze, aluminum, Monel, stainless steel and semi-steel and semi-steel. Request a copy of free Bulletin F-10.

\*OPW Corp. \*OPW Corp

Distributors, Tower.....Two new tower distributors, "Multi-Level" for low liquid rates and "Weir-Flow" for medium to high liquid rates, are described in Bulletin TA-30. Available on requise described in Ban-able on request. \*U. S. Stoneware Co.

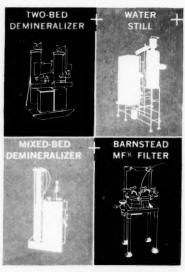
Electrical Equipment.....20 p. catalog contains illustrated descriptions of Temco line of lab and industrial equipment including electric furnaces, hot plates, temperature con-trollers, Catalog 57.

226C Thermo Electric Mfg. Co.

losures.....Spin Top enclosure is available in three ways—complete device, enclosure only, or components only—for reversing and non-reversing across-the-line & combination starters. Bul. 9990.

\*Square D Co.

\* From advertisement, this issue



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This entirely new standard of water purification by Barnstead now makes new advances possible in Chemical, Electronic, and Nuclear fields, where water of the highest purity is needed.

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#### **NEW LITERATURE:**

Catalog "G" describes Barnstead line of Water Stills from 1/2 to 1000 g.p.h. Catalog 127, lists Mixed-Bed, Bed, and Four-Bed Demineralizers. Bulletin 141, on MF Filter which filters out particles to 0.45 micron.



BOSTON JAmaica 4-3100 NEW YORK Kingsbridge 8-1557 CHICAGO

6-0588

JOHNSON CITY 3113

PHILADELPHIA L0cust 8-1796

LOS ANGELES SAN FRANCISCO TEmplebar 2-5391

RYan 1-9373 CHATTANOOGA 6-5863

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19 Lanesville Terrace, Boston 31, Mass.

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Write for Catalog I



LITERATURE . . .

Engines, Gas Turbine.....500 HP Jupiter gas turbine is a simple heat engine suited to applications with interrelated requirements for shaft power, processing heat and compressed air. Booklet.

\*Solar Aircraft Co.

offer the double protection of rugged corrosion-resistant cast iron frames and dripproof enclosures. They are light in weight and take less space. Bulletin MU-223. \*Wagner Electric Corp.

Transmission Equipment . . . . . Company offers Bulletin A-640-A on dry fluid drives and couplings, Bulletin A-638 on roller bearings, and Bulletin A-606-A on sealed-life V-belts. Free on request.

172-3 °Dodge Mfg. Co

bines, Steam.....Coppus steam turbines, ranging from 150 hp down to fractional, in six frame sizes, make your turbine dollars go further. Bulletin 135 is now available on request. Turbines, \*Coppus Engrg. Corp. 63

ons.....Free, 16-page handbook entitled "What Makes a Good Union" helps you select unions with pressure-tightness, durability and other advantages. It is a good train-ing textbook, too. 201 "Clayton Mark & Co.

V-Belt Drives.. .108 p. manual con-Dodge Mfg. Corp. 227B

Welding Fittings.....The dimensional accuracy of B&W welding fittings makes a welder's job easier and his work more precise. Every fitting has true circularity and full radius. Bulletin FESOR. true circularity true circularity Bulletin FB504.
\*Babcock & Wilcox Co.

#### Handling & Packaging

Checkweighing Machines... ... Selectrol weight accuracies from one part in 5,000 to one in 20,000. Capacities vary from one gram to 100 pounds. Described in Form 3347 and 3269. 227C Exact Weight Scale Co.

veyors, Screw.....Full line of screw conveyor components in-cludes 17 basic screw designs, avail-able in a variety of metals. Also troughs, hangers, seals, couplings, gates, etc. Book 2289. 21 \*Link-Belt Co. Conveyors,

sts, Air.....Air hoists provide lift-ing power that is safe from fire and explosion hazards, with easily con-trolled speed for a swift, steady lift. Sizes from 150 lb. to 2 tons. Bulletin

\*Gardner-Denver Co.

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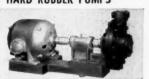
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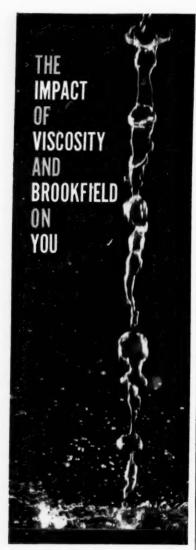
The LUZERNE RUBBER CO.

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ALBERT J. COX CO. R. C. FOLTZ CO.

Chicago, III. Houston, Texas

<sup>\*</sup> From advertisement, this issue



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Brookfield

ENGINEERING LABORATORIES INCORPORATED STOUGHTON 13 MASSACHUSETTS LITERATURE . . .

aks.....Atlas process tanks use a mild steel or concrete shell pro-tected by corrosion-proof linings and acid brick sheathing joined with corrosion-proof cements. Bul-letins 5-2 and C-1 offered. R187 \*Atlas Mineral Products. Tanks.

#### Heating & Cooling

Condensers, Vapor.....Aero air-cooled vapor condensers give more capacity than other types at a sub-stantial saving of steam and power. Assures constant temperature. Ask for Bulletin 129R. \*Niagara Blower Co.

Evaporators.....Food, chemical, phar-maceutical—whatever your process-ing need, there is a custom-designed, custom-engineered evaporator that will help improve your product qual-ity. "An Open Door." 85 "Swenson Evaporator Co.

Generators, Steam.....Line of packaged steam generators have capacities of from 10,000 to 60,000 lb/hr, with wide choice of burners and controls. For further details, request Bulletin PG-55-3.

79a \*Foster Wheeler Corp.

Generators, Steam.....Standard units offer all the advantages and economies of standardization for industrial steam generators of from 50,000 to 450,000 lb/hr capacity. Bul. B-55-4. \*Foster Wheeler Corp.

t Exchangers.....Wherever you need to cool a fluid and have a problem of water supply or disposal, Aero heat exchangers will help. Atmospheric air cools liquids and gases. Bulletins 120, 124, 135.

TL203 \*Niagara Blower Co. Heat

Heaters, Dielectric . . . . Company's line of dielectric heaters for non-conducting materials extends from a 3-kw unit to 100-kw and larger machines. Ovens, cages and other accessories, Bul. 15B6431C.

115 \*Allis-Chalmers Mfg. Co.

duction Units.....12 p. catalog describes line of high frequency induction units and accessories for rapid high temperature combustion of laboratory samples. Bulletin T-1067 available. Induction Units ... Lindberg Engineering Co.

Kilns, Rotary.....Rugged, dependable rotary kilns have steel plate shells, full-floating tires, drives with the main pinion of cast, forged or tool steel on an adjustable base. Bul-letin 1115. 114 \*Traylor Eng. & Mfg. Co.

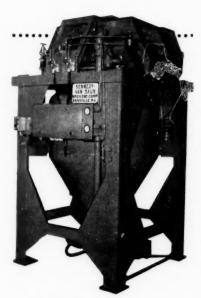
ns.....New 8-page color illustrated brochure describes re-designed models of four laboratory ovens and six production type ovens in stand-ard, heavy duty and super duty capacities. Bulletin 100. T234 \*Despatch Oven Co. Ovens.

Thermo - Panels ..... Thermo - panel coils provide a perfectly safe way to warm drums, tanks and cans of highly volatile fluid. Also usable for cooling. Request Bulletins 355 and 258.

BP237 \*Deep Products Inc. BR237 \*Dean Products Inc.

\* From advertisement, this issue

# **PNEUMATIC** CONVEYING



- No motors
- No feed screws
- . No moving parts while conveying
- · Measures quantities conveyed, automatically
- · Higher pressures for higher efficiency -smaller pipelines
- · Air used only while conveying
- Adaptable to full automation
- Handles several materials without contamination

**KENNEDY Pneumatic Conveying Systems** handle powdered or granular materials at less cost.

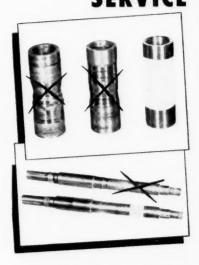
Write today for literature.



#### KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION TWO PARK AVENUE, NEW YORK 16. H. V. . FACTORY: DARVILLE, PA

# Eliminate "CHEWED UP" SHAFTS with CHEMPRO SPRAYED CERAMIC SERVICE



Chempro's new extremely hard, chemically inert ceramic coatings applied to shafts and shaft sleeves eliminate the costly failure of "chewed up" or "scored" shafts and sleeves. Sprayed ceramic surfaces are highly resistant to abrasion, erosion and fretting corrosion under even the most difficult slurry service. They also give ideal protection against shaft wear under high packing gland pressures.

Pump down-time due to shaft or sleeve failure has been drastically reduced in every installation in which Chempro's sprayed ceramic surfacing has been used.

Write for new Chempro Bulletin CP28 for ordering information.



LITERATURE . . .

Traps, Steam.....New booklet entitled
"The Why and How of Steam
Trapping" discusses the advantages of Yarway steam traps, including 24-hour a day performance,
small size, small inventory of parts.
29

\*Yarnall-Waring Co.

#### Instruments & Controls

Analyzers, Oxygen.....Unitized oxygen analyzer has direct magnetic operation without auxiliary gas supplies, chemical reactions or combustion. Pertinent details available in Folder ND46-91(5).

50 \*Leeds & Northrup Co.

Analyzers, Particle Size.....New particle size analyzer is a general-purpose device for measuring size distribution of small particles, especially those between 0.1 and 40 microns. Bul.

31 \*Mine Safety Appliances Co.

Borescopes ..... Comprehensive, elaborately illustrated booklet gives practical information on the use of borescopes for the inspection of interior areas or surfaces not otherwise visible.

B235 \*Amer. Cystoscope Makers Inc.

Controls, Pressure..... Company offers literature on their automatic pressure controls. Bul. 5-5 on Type H5 (maximum 500 psi), Bul. 5-7 on J7 (maximum 200 psi), Bul. 5-9 on J40 (maximum 250 psi).

229A United Electric Controls.

Controls, Temperature.....Company offers detailed data on complete line of remote bulb temperature controls in an attractively illustrated brochure, Catalog Section 200. Send for it now.

202 \*United Electric Controls Co.

Controller, Liquid Flow.....12 p. bulletin, No. 900, describes Type S controller, a device used to regulate flows of liquids in a line and specifically in filter plants.

229B Simplex Valve & Meter Co.

Gages, Liquid Level.....Penberthy gages give you clear, accurate liquid-level readings in all tanks, boilers, vessels, containers and flow lines. Catalog 36 tells about line and accessories.

\*Penberthy Mfg. Co.

Instruments, Viscosity . . . . Thousands of profitable processes depend upon accurate viscosity control. Company offers a fully descriptive brochure illustrating viscometers and allied equipment.

L228 \*Brookfield Eng. Labs.

Potentiometers . . . . . Dynalog electronic potentiometers respond almost instantly to the slightest change in a process variable, with a sensitivity of 1/100 of 1% of scale. Request Bulletin 20-10.

55 \*Foxboro Co.

Pyrometers . . . . Portable pyrometer indicator can be used for a wide range of temperature measurement, calibration and test purposes. Widely spaced graduations for easy reading. Bulletin 64-E. 231 "Thermo Electric Co.

• From advertisement, this issue





Increased efficiency in removing solvent from solids during processing provides an excellent opportunity to reduce costs. The French Desolventizer (DT) represents a significant advance in the removal and recovery of solvent from extracted solids. Its efficiency has been proven in many plant applications. Send details of your processing problem.







When corrosion is a troublesome factor in processing—at high temperatures or low-specify W-S 150 lb. Stainless Steel Fittings and eliminate a major cause for piping equipment failure. W-S 150 lb. fittings are available in stainless steel types 304 and 316...with screw ends or welding sockets...in sizes 1/8" to 4"...and as elbows, tees, crosses, couplings, half couplings, reducers, caps, plugs, bushings and unions.

Triple-service W-S fittings of this type are lightweight and exceptionally strong. They're your safeguard in petroleum, chemical, petrochemical, food and other process operations.

For technical information, write today for Bulletin S-3.

WORKING UNDER PRESSURE? W-S HAS A FITTING ANSWER. W-S manufactures a full range of high quality drop forged fittings, unions and couplets. in carbon, stainless and alloy steels. For full information about these products, or for your commercial forging and die casting requirements, write to: Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.

#### H. K. PORTER COMPANY, INC.

FORGE AND FITTINGS DIVISION

Regulators, Voltage ..... Stabiline instantaneous electronic and electro mechanical automatic voltage regulators will give you peak per-formance and lower costs. Bulletin S 351 contains charts. Superior Electric Co.

Testing Equipment.... "Self-file" cat-alog offers complete specs, typical applications and performance curves on voltmeters, capacitance bridges, distortion meters and UHF gride, din meters gride dip meters.
230B Boonton Electronics Corp

#### Pipe, Fittings, Valves

sings.....The first nuclear-powered surface ship, the "Long Beach", will use Midwest welding elbows of special heavy wall stainless steel. Whether or not you use atomic power, Cat. 54 will help. "Midwest Piping Co.

Fittings, Stainless Steel.....Stainless steel fittings provide low temperature toughness, heat resistance and corrosion resistance. They are lightweight and strong. Bulletin S-3.

230 \*H. K. Porter Co.

Joints, Expansion.....Garlock expansion joints can protect your costly piping from damage caused by shock, vibration, expansion or contraction. Teflon, Teflon-lined or rubber. Folder AD-137.

51 \*Garlock Packing Co.

Nozzles, Spray.....You have a choice of over 12,000 basic designs of spray nozzles in brass, stainless steel and several other materials to fit your specifications. Send for a copy of atalog 24.

\*Spraying Systems Co. TL197

zles, Spray.....Company furnishes nozzles for scrubbing corrosive gases, oil atomizing, humidifying, air washing, desuperheating, spray ponds, milk powdering, etc. Send for free Catalog 1.

L227 \*Monarch Mfg. Works.

Pipe, Plastic.....Ace Parian is odor-less, tasteless, rigid polyethylene. Pipe comes in sizes ½" to 2", has excellent impact strength at sub-zero temperatures. Request Bulle-351 now. \*Amer. Hard Rubber Co.

Pipe, Plastic.....Ace Riviclor is a new rigid threaded plastic pipe with good aging and high impact strength. Not affected by most in-organic acids and alkalis. Sizes ½" to 4". Bulletin CE-56. 174d \*Amer. Hard Rubber Co.

Pipe, Polyvinyl Chloride.....National polyvinyl chloride pipe comes in two types, normal impact for the highest chemical resistance, and high impact for good resistance and high toughness. Bul. 24.

54 \*U. S. Steel Co.

e, Plastic ..... General-purpose moderately priced rubber-plastic pipe handles most common chem-icals to 170 degrees F. It is tough, odorless and tasteless. Send for in-formative Bulletin 80. 174b \*Amer. Hard Rubber Co. Pine.

<sup>\*</sup> From advertisement, this issue

Pipe Sheet. Company 80 offers booklets on its rigid Koroseal polyvinyl pipe and sheet, which is un-affected by most alkalies and acids, easy to install, non-flammable. Request copies. 246 \*B. F. Goodrich Ind. Prods.

Tubing . . . . Trentweld tubing comes in sizes ranging from '%" to 40" O.D. and in a wide range of grades, all made by an exclusive welding process which almost eliminates the bead. Reuest Handbook. \*Trent Tube Co.

Tubing, Armored . . . . Armored Multi-tube is a group of 2 to 37 metal or polyethylene tubes spirally cabled together and protected by galvan-ized steel armor or a thermoplastic sheath. Bul. 356-H. TL187 \*Crescent Insulated Wire.

Excellent chem-flexible Tubing, Plastic.....Excellent chemical-resistant, all-purpose flexible plastic tubing is sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. Bulletin 66.

174e \*Amer. Hard Rubber Co.

Valves.....New line of general purpose drop forged steel valves have broad adaptability to many industrial applications, permitting a reduction in operating overhead. Cat. Supplement 1. \*Henry Vogt Machine Co. 10-1

Valves.....Company offers the full facts on "Craneloy 20" and other Crane quality alloy valves and fittings in Circular AD-2080. For every process fluid, including corrosive ones.

\*Crane Co.

ves, Check.....Technocheck poly-vinyl chloride check valves are rugged, versatile, tight sealing and operate on low pressure differential. Sizes from 1" to 8". Bulletin Tech-nocheck-PVC. B199 Valves. Check... \*Techno Corp.

Valves, Lubricated Plug. . . . Lubricated plug valves have reinforced Teflon head seal, double ball and lubricant sealed check valve, controlled pressurized lubricant seal. Reference Book 39, Sect. 5.

23 \*Homestead Valve Mfg. Co.

Valves, Needle.....Corrosion resistant, durable stainless steel needle valve is guaranteed for working pressure up to 10,000 psi and is equally efficient at any lower pressure. Bulle-tin NV-2. T233 \*Marsh Instrument Co.

Valves, Plastic . . . . Plastic diaphragm valves for all-plastic piping systems come in Ace-ite, Ace Parian or Ace Saran. Handle most corrosive chemicals and food ingredients. Buls. 80 & 351. 174e \*Amer. Hard Rubber Co

#### Process Equipment

Absorbers, Gas......Gas absorbers are designed for removal and/or recovery of soluble gases, vapors and mists from exhaust systems before discharge into the atmosphere. Buls. AP-225 & AP-2500. \*Buffalo Forge Co. 108c

\* From advertisement, this issue



The "MiniMite" Portable Pyrometer Indicator gives you laboratory accuracy-in a rugged, versatile instrument. You can use it dependably for a wide range of temperature measurement, calibration and test purposes. Carry it around and set it up wherever you need it. Heavy use won't impair its performance or accuracy.

#### **Temperature Measurement**

When connected to a thermocouple the "MiniMite" will measure temperature directly. Use it for laboratory work, emergency operation, or as a substitute for instruments under repair. It's also ideal for a wide variety of research and test work. Automatic cold-junction compensation is built-in.

#### Calibration

You can use the "MiniMite" to calibrate thermocouples-also both potentiometer and millivoltmeter-type instruments. For calibrating millivoltmeters, T-E offers a portable sister instrument, the "MilliMite," as a variable source of D.C. potential and resistance.

#### Scale Range

Despite the "MiniMite's" small size, individual ranges on its double-range scale are almost 24" long. A choice of 49 different range combinations covers temperatures from -300°F, to +3200°F. for Copper-Constantan, Iron-Constantan, Chromel-Alumel and Platinum-Rhodium-Platinumand millivolts from -6.2 to +62. Accuracy is ¼ of 1% of scale range.

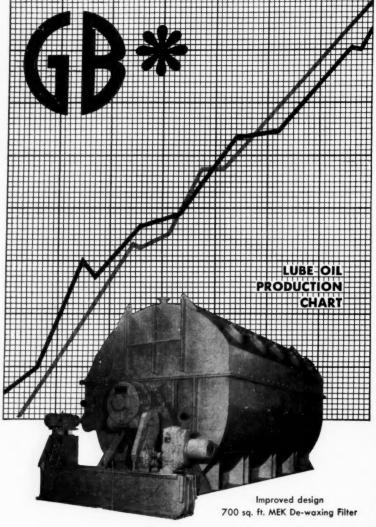
#### Convenience

The "MiniMite" measures only 4" x 5" x 6" and weighs under 4 lbs. It will function in either horizontal or vertical position. Widely spaced graduations permit easy, accurate readings. Cold-junction compensation can be cut in or out by a single switch.

Write For Bulletin 64- E



In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.



# \*means Good Business...

Over 25 years of experience assure you that Goslin-Birmingham can produce the best de-waxing filter to fit your requirements regardless of the process.

G-B has manufactured more de-waxing filters than any other producer...by many times the largest volume in the industry.



GOSLIN-BIRMINGHAM
MANUFACTURING CO., INC.
BIRMINGHAM, ALABAMA

Agitators & Mixers.....Patented standpipe around propeller shaft assures positive agitation and circulation. Heavy-duty and acid-proof construction are available. Request Bulletin A2-B4.

198a \*Denver Equipment Co.

Centrifuges . . . . Titan Superjector centrifuge periodically ejects sludge automatically while running at full speed and cleans itself in ten seconds or less. Request Bulletin 946 now.

248 \*Pfaudler Co.

Crushers, Jaw.....Cast steel frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and increase life of roller bearings in the bumper. Bulletin C12-B12.

Denver Equipment Co.

Dryers..... Standard dryers are available in several types: direct heat, indirect heat and steam tube. Sizes 2'x15' to 5'x40' and larger. No problem too large or too small. Bulletin D4-B2.

198j \*Denver Equipment Co.

Dryers.....Hydryers are ideal for lowcost drying of instrument air as well as compressed air for air control systems. No waste, no purging, no moving parts. Request Bulletin 16.0.081.

\*J. F. Pritchard & Co.

Dryers, Rotary.....Rotary flash dryers in package units fired with natural gas, with automatic controls, are discussed in Catalog "A" along with other pressing, drying and cooling equipment.

BL203 \*Davenport Mach. & Fndry.

Dust Collectors.....Type W Roto-Clone collects the finest, lightest dust particles, requires little maintenance, uses a minimum of water. Complete information is available in Bulletin 272B. 32 \*American Air Filter Co.

Dust Collectors . . . . Efficient Pangborn dust collectors trap dust at the source and gather it ready for resale, re-use or disposal. They make possible longer machinery life, lower costs. Bulletin 922.

40 Pangborn Corp.

Dust Control.....By trapping dust at its source, you can eliminate health and safety hazards, lengthen machine life, cut plant housekeeping costs. Bulletin 800 is available on request.

24

\*Dracco Div.

Dust Filters.....Self-cleaning dust filter, the Dynaclone, has new roller cleaner for cleaning dust from filter bags. This and other dust filters are described in 36-page Bulletin 104.

\*W. W. Sly Mfg. Co.

Dust Filters.....If your problem is collecting and recovering valuable dust or controlling dangerous or obnoxious dust, "Dust Filter Facts" will help. Contains charts and engineering data. Bul. F-75.

223 \*Day Co.

Feeders.....Wet reagent feeder accurately meters minute quantities of liquid from 0 cc. to 2000 cc. per minute. Handwheel adjustment to control amount of liquid is simple, accurate. Bul. F6-B9.

198e \*Denver Equipment Co.

\* From advertisement, this issue

Fiberpress.....Bulletin 190 gives details of Sprout-Waldron/Anderson Fiberpress which fiberizes while it removes dissolved solids at high concentrations. Engineering drawings, photos included. 233A Sprout, Waldron & Co.

Filter Fabrics.....Wet filtration fabrics of Daynel resist a variety of acids, bases, oxidizing agents and solvents. Dynel is now being used in air filters. Booklet has guide to chemical resistance.

49

\*Union Carbide Chem. Co.

Filter Presses. . . . . Catalog is an up-to-date, fully illustrated reference manual of erection, operating, design and construction data and specifications for filter presses. Request a copy now.

193 \*D. R. Sperry & Co.

Filters.....Company offers Bulletin 651, covering diatomite filters for high quality process water, and Bulletin 909, on an automatic water filter for recirculation systems in less critical uses. \*R. P. Adams Co.

Filters, Disc..... Special design of segments in disc filters uses both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Get Bulletin FG-Bl. 198f \*Denver Equipment Co.

Filter-Separator.....File of data on Reco 15-gpm. filter-separator includes checklist of 49 industrial and commercial liquids which can be continuously cleaned by the unit. Also spees, drawings. 233B Richmond Engineering Co.

Filtration Equipment.....Catalog describes Fulflo and CFC filtration equipment for micronic clarification of all types of fluids. Filters are designed for high or low flow rates and pressures.

233e Commercial Filters Corp.

Flotation Equipment.....Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. "Sub-A's" give maximum recovery at low cost. Bulletin F10-B81. 198g \*Denver Equipment Co.

Fume Scrubbers.....SK fume scrubbers can control objectionable or dangerous fumes, gases, vapors and dusts. They are low in cost, require little maintenance. Full information in Bulletin 49

in Bulletin 4R.
151a \*Schutte & Koerting Co.

Mills, Ball.....Steel head ball mills have five types of discharge trunnions, all-steel construction and low initial cost. Laboratory and pilot plant mills are also available. Bulletin B2-B13.

198b \*Denver Equipment Co.

Mixers....New Triple Action mixer gives uniform blending and mixing in 2 to 7 minutes with 99.9% thorough distribution of minor additives. Company offers free color bulletin with details.

95 \*Strong-Scott Mfg. Co.

Propellers.....Now you can obtain "fabricated" propellers accurately balanced and pitched for mixing, blending, stirring, pumping or aerating in applications needing relatively low horsepower. Cat.

BL187 "Michigan Wheel Co.

• From advertisement, this issue







#### Get this new buying guide for LABORATORY and PRODUCTION OVENS

New 8-page color illustrated brochure describes re-designed models of four laboratory ovens and six production type ovens in Standard, Heavy Duty and Super Duty Capacities

Comprehensive diagrams showing the Despatch "Whirlblast" Forced Air convection systems are included. Construction and engineering features are clearly illustrated by separate photographs of important components. Pictures show typical installations and give specifications of 10 models of gas and electric fired ovens in the Despatch "V" series. Discover how Despatch Engineering Service can help you with your selection of a new oven that will exactly fulfill your needs.

write for your copy of BULLETIN # 100 now



#### DESPATCH OVEN COMPANY

405 8th Street S.E. Minneapolis 14, Minnesota

#### REDUCE OPERATING COST of VACUUM SYSTEMS with this "AERO" (air-cooled) VAPOR CONDENSER

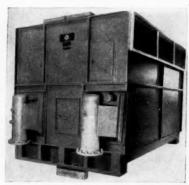
With free air the cooling medium, you use the least water, evaporated in the air stream. You save the cost and pumping of large volumes of condensing water.

Air-vapor subcooling reduces mixture evacuated from the system, saving in the operation of steam ejector

or vacuum pump.

This air-cooled condenser gives you more capacity than other types at a substantial saving of steam and power. Water supply, scaling treatment and disposal problems are eliminated.

You get pure condensate, an improved product; often profit by recovery of residues now wasted. There can be no contamination of your product at any time; it never touches raw water. Condensing, of water, of solvents or of your product, is simplified; you have one, compact, easily maintained unit replacing both cooling tower and barometric or surface type condenser.



Niagara Aero Vapor Condenser Panel Casing ection gives access to all parts, saves first costs in shipping and installation.

Maintenance expense is low. Niagara Aero Vapor Condenser Panel Casing construction gives access to all parts, saves first costs in shipping and installation. Summer-winter dampers and Balanced Wet Bulb Control provide precise, year 'round adjustment of capacity to load.

Constant temperature, uniform products and maximum production 12 months a year are assured. Capacities up to 15 million BTU/hr.

Write for full information. Ask for Bulletin 129R

#### NIAGARA BLOWER COMPANY

Dept. CE-2, 405 Lexington Ave., New York 17, N.Y. Niagara District Engineers in Principal Cities of U.S. and Canada Samplers..... Heavy-duty units, extra rigid track and ball-bearing wheels of automatic samplers assure positive travel and timing of sample cutter. Wet and dry cutters. Bulletin S1-84.

\*Denver Equipment Co.

arators, Air.....Fines that pass through grinding mills unhindered can be classified by an air separa-tor operating in closed circuit, and all oversize returned for further grinding. Bul. 087. 22 \*Sturtevant Mill Co. Separators,

Is & Demineralizers.....Catalog
"G" describes line of water stills
from ½ to 1000 gallons per hour
capacity. Catalog 127-A describes
two-bed, four-bed and mixed-bed
deminizers lights. Stills & demineralizers \*Barnstead Still & Demin.

Tables. Concentration . . . . Mechanically operated concentration tables separate materials into bands and handle the coarsest sands with excellent results. Process 5 to 150 tons per 24 hrs. Bul. Ti-B3.

198h \*Denver Equipment Co.

Water Processing Equipment.....Company offers Catalog "G" on line of water stills, Catalog 127 on mixedbed, two-bed and four-bed demineralizers and Bulletin 141 on MF filters. Free.

R226 "Barnstead Still & Demin.

Wire Cloth.....When you call Cambridge for industrial wire cloth and screen, in bulk or fabricated parts, inquiries are answered promptly, deliveries made on time. Request 94-page catalog. 224 \*Cambridge Wire Cloth Co.

#### Pumps, Blowers, Compressors

Compressors.....WG-9 oil-free compressors have carbon graphite piston rings which need no lubrication and compensate automatically for wear. Part of a full line of compressors. Bul. 104-11. Joy Mfg. Co.

Compressors.....CRX carbon piston compressors give pure, oil-free air for processing or instrumentation, with no oil or water lubrication re-quired. Bulletin CRC-10 will give you full details. 170 \*Gardner-Denver Co.

Compressors, Rotary . . . . . 1-2 hp. pumps, smaller and lighter than reciprocating compressors of equivalent output, supply air in 150-175 psi. range. 8 p. folder explains operating principle with diagrams.

234A American Brake Shoe Co.

Fans, Fume.....Type "FG" fume fans provide superior chemical resist-ance to a variety of corrosives, in-cluding acids, salts, gases. Fan housing is resin-bonded fiber glass. housing is resin Bulletin FI-511. \*Buffalo Forge Co.

mps.....Twin-Lobe positive dis-placement pump combines sim-plicity of construction with high performance, wide range of uses. G.T.A./TLP-57 Bulletin contains description and application guide. 180-1 \*Manton Gaulin Mfg. Co. Pumps.....Twin-Lobe

<sup>\*</sup> From advertisement, this issue

nps.....New self-priming liquid ring pump handles any combination of air and liquid. Even with loops or leaks in the suction line, it keeps Pumps. the liquid moving. Bulletin 725.6. Request free \*Goulds Pumps Inc 211

nps.....SSV centrifugal pumps, in enclosed impeller and open impeller types, are custom-made to fit your particular operation, whatever con-Pumps sistency or type liquid you move. Bul. 107. R197 \*Frederick Iron & Steel Inc.

Pumps.....Practical guide to pump selection contains big illustrations and brief descriptions and data on the capacities and adaptability of company's line of pumps. Request Bulletin S-146. \*Taber Pump Co.

Pumps.....Viking pumps are helping our Air Force with the de-icing, defrosting and decontaminating of parked aircraft. Other uses for pumps which lift liquids under pressure are found in Bul. 58SC. T235 \*Viking Pump Co.

nps, Acid . . . . Centrifugal acid pump has a hard rubber casing and impeller and a Hastelloy C shaft. It handles nearly all corrosives and is mechanically simple and trouble-free. Bulletin CE-55.

175e \*Amer. Hard Rubber Co. Pumps,

Pumps, Vacuum . . . . . Company offers Catalog 752, "Stokes Microvac Pumps for High Vacuum" and Booklet 755, "How to Care for Your Vacuum Pump". Minimum main-tenance and wide pressure range. 44 °F. J. Stokes Corp.

#### Services, Processes, Misc.

Conversion Factors. Wall chart of conversion factors is ideal reference table for engineers. Includes such common conversions as in. to cm., watts to hp., cu. ft. to liters. watts to hp., cu. ft. to liters.

Precision Equipment Co.

Extinguishers....New pressurized dry chemical portable fire extinguishers attack flammable liquid or electrical fires. Automatic unlocking device and trigger control. Catalog P-40.

190 \*Walter Kidde & Co. Fire Extinguishers.

Laboratory Equipment.....Batch or continuous test models of crushers, ball mills, pulverizers, rod mills, classifiers, agitators, pulp distributors, feeders, pumps, etc. Bulletin LG3-B10. \*Denver Equipment Co.

Laboratory Furniture....This company can show you how to obtain the maximum working and storage area in a minimum of space and how to make current equipment adaptable to future uses. Catalog. 235B Metalab Equipment Co.

Tank Vents & Flame Arrestors.....

For surest protection for volatile liquids in storage, safeguard your tanks with lightweight tank vents and flame arrestors. Full information in Catalog 76-16. \*Black, Sivalls & Bryson. 179



help de-ice planes

Model HL-195 Viking Pump Operates at 1800 RPM

Units built by Pitman Manufacturing Company, Kansas City, Missouri, are helping the U. S. Air Force answer the problem of de-icing, defrosting and de-contaminating parked aircraft. An integral part of each unit is a Viking HL-195 Pump. Positive action of pump delivers fluids to 50-foot high platform, under pressure of 100 psi, for spraying planes. If you have the problem of lifting liquids under pressure, better

For information, see your nearby distributor or write for bulletin 585C.



investigate Viking Pumps.

#### VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A In Canada, it's "ROTO-KING" pumps See our catalog in Sweet's Plant Engineers File.



<sup>\*</sup> From advertisement, this issue



# Solvents Have Nine Lives Too?

'Course they do! Vaporized solvents can be used again and again! Witchcraft? No, solvent recovery does the trick.

Solvent recovery is the efficient, economical way to recover solvents vaporized in manufacturing processes. What solvents? Count 'em: alcohols, esters, ethers. ketones, hydrocarbons, chlorinated compounds and practically all mixtures of these solvents can be recovered and reused. And look at these vital statistics . . . efficiency-more than 99%: cost-1 to 26 per pound.

Here's how solvent recovery works, Vapor laden air is drawn from the evaporation process and passed through a bed of activated carbon. The solvent vapor is adsorbed on the carbon and the denuded air is discharged into the atmosphere. When the carbon becomes saturated, the vapor laden air is switched to a second adsorber.

Then, low pressure steam drives the solvent out of the carbon bed and the steam-solvent mixture is condensed. If the solvent is insoluble in water, an automatic decanter separates the mixture. If the solvent is water-soluble, distillation does the job.

CARBIDE has much more information on how a COLUMBIA Activated Carbon Solvent Recovery system can recover your process solvents. Write now!

#### UNION CARBIDE CHEMICALS COMPANY

Division of CARBIDE

Corporation

30 East 42nd Street, New York 17, N. Y.

"Columbia" is a registered trade-mark of UCC.

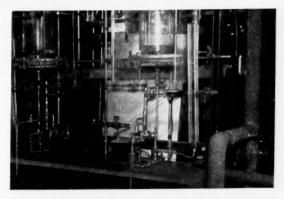
#### READER SERVICE . . .

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- -550 gal. 304 S.S. jacketed agitated Reactors with Chromalox Heating Ele-ments, oil jackets and condensers
- -500 gal. 304 S.S. jacketed agitated Reactor with condenser
- -500 gal. Pfaudler glass lined agitated Reactors.
- -300 to 450 gal. 304 S.S. agitated Kettles -300 gal. 304 S.S. jacketed agitated
- Reactor 300 gal. steel jacketed Kettles 3' x 6'
- -250 gal. Steel jacketed Kettles 41" x 46" deep
- -200 gal. 304 S.S. Vacuum Stills with condensers.
- -125 gal. 304 S.S. Kettles 3—20 and 30 gal. 304 S.S. Vacuum Stills with condensers.

#### **TANKS**

- 5-2000 gal. 304 S.S. Tanks 7' x 7' high, agitated (3 with s.s. coils).
  2-2000 gal. Steel Tanks 7' x 7' high, closed agitated with steam coils.
  1-1000 gal. Steel Tank 64" x 68" high, dished top and bottom, agitated with
- coils and bottom, dynamed with coils 6-000 gal. 304 S.S. Tanks 54" x 54" high -325 gal. 304 S.S. Tank 44" x 54" high -300 gal. Plaudler glass lined Agiated Mixing Tanks 44" x 48" high -125 gal. 304 S.S. Tanks 40" x 24" high -125 to 150 gal. Plaudler glass lined jacketed Crystallizing Tanks 40" x 24" and 40" x 30" gal. Plaudler glass lined jacketed Crystallizing Tanks 40" x 30" high 18" cone bottom -75 to 150 gal. Plaudler glass lined Crystallizing Tanks -50 gal. General Ceramic Crocks

#### **WOOD TANKS**

- –2300 gal. Cypress Tanks 7' x 8' high, agitated 2-3/4" staves
- -2000 gal. Cypress Tanks 7' x 8' high, agitated 2-1/2" staves
- -1200 gal. Cypress Tank 6' x 6' high, agitated 1-3/4" staves

#### **EVAPORATORS**

1—Condenser Service & Engineering 304 S.S. Evaporator, 1000 gal. Single Effect Body with Vapor Dome and Vertical Condenser, condensate Pump.

- 2-Oliver United No. 50 304 S.S. Pressure
- -Oliver United no. of the Color of the Color
- hers
  1—Independent Filter Press 30" x 30"
  wood plate and frame, 25 chambers
  6—Independent & Shriver Filter Presses
  18" x 18", 24" x 24" wood
  12—U.S. Stone Ware & General Ceramic
  Vacuum Filters, 25 gal. top, 50 gal.
  bottom.

#### DRYERS

- Proctor & Schwartz Atmospheric Tray Dryers, two section, aero-fin steam coils, fans. XP motor, 68 S.S. trays each 20" x 30"
- -Hemminger Tray Dryer, 8 sections, aero-fin steam coils, 176 S.S. trays 20" x 30"

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- PUMPS—COMPRESSORS

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- 3—Louisville 6' x 50' Rotary Steam Tube Dryers, reducer and 20 HP motor
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- 1—Bird 40" suspended, rubber covered, perforated basket Centrifuge 2—AT&M 42" suspended, Stainless Steel, perforated basket Centrifuges
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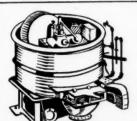
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- 10—Pfaudler 1000 gallon Glass-lined Series R Jacketed Kettles.
- 2—Glascote Glass-lined Jacketed Stills, 150 gallons, Complete.
- I—Pfaudler Glass-lined Jacketed Reactor with Agitator and Drive, 50 gallons.
- 1-Pfaudler Glass-lined Jacketed Series P Kettle, 100 gallon
- 10-Pfaudler 1000 gallon Glass-lined Vacuum Receivers
- 5-Stainless Steel Jacketed Reactors, 200 gallons to 1000 gallons
- 2-Aluminum Vertical Storage Tanks, 12,000 gallons

#### MISCELLANEOUS

- 2—Struthers Wells Type 316 Stainless Steel ReBoilers, 445 sq. ft. and 380 sq. ft.
- 1—Richmond Engineering Type 316 Stainless Steel Heat Exchanger, 350 sq. ft.
- 4-Type 317 Stainless Steel Heat Exchangers, 892 sq. ft.
- 1-Stokes Stainless Steel Rotary Vacuum Dryer, 3' x 15'
- 1-Merco Stainless Steel Centrifuge, Type B9
- 1—Feinc Stainless Steel Rotary String Filter, 3' x 3' (New)

Established 1886

R. GELB & SONS, Inc.

U.S.HIGHWAY No.22, UNION, N.J. • MUrdock 6-4900

# **B.F.Goodrich**



# How Koroseal helps cut cost of nickel-plating jewelry

THE Victory Polishing and Plating Company of Providence, Rhode Island specializes in the nickel-plating of jewelry, turning out such items as nickel-plated cuff links, tie bars, necklace chains and pins. The nickel solution used is highly corrosive and runs at an almost constant 130°F. Ordinary "acid-resistant" hoses continued to fail—they couldn't take the combined assault of corrosion and heat.

Then, in the summer of 1956, the company installed B. F. Goodrich Koroseal rigid polyvinyl chloride pipe. Result: absolutely no maintenance is required, and close examination shows no apparent wear. This company is replacing all of its "acid-resistant" hose with Koroseal pipe, and has lined

all its acid storage tanks with rigid Koroseal PVC plate.

Versatile Koroseal has answered countless problems for alert manufacturers. Koroseal is unaffected by most alkalies and acids, and is completely inert in the presence of oil, alcohol, and salt solutions.

Exceptionally easy to install, Koroseal PVC can be threaded, cut, welded or drilled. It has excellent insulation properties, will not support combustion, and never needs painting.

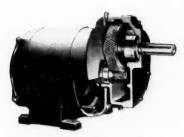
Find out how this light, inexpensive, long-wearing pipe can make your operations more efficient. Fill in and mail the coupon on the right. B.F. Goodrich Industrial Products Company, Marietta,



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Please send r	me free booklets on:
	Rigid Koroseal Pipe Rigid Koroseal Sheet
Name	
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Master Gearmotors are available with all Master motor types in right angle and parallel construction. We *make* a lot of Gearmotors here at Master. The point is, we've been *selling* more than all other makes combined. There are more Master Gearmotors in *use* than all others. Users *buy* more. And you don't find any foolish motor buyers—or not for long.

So it's obvious that Master Gearmotors simply must meet most requirements best. If you're not a Master Gearmotor user, now's the time to find out what you're missing!

#### IT'S TIME YOUR DRIVE REQUIREMENT MEETS ITS MASTER

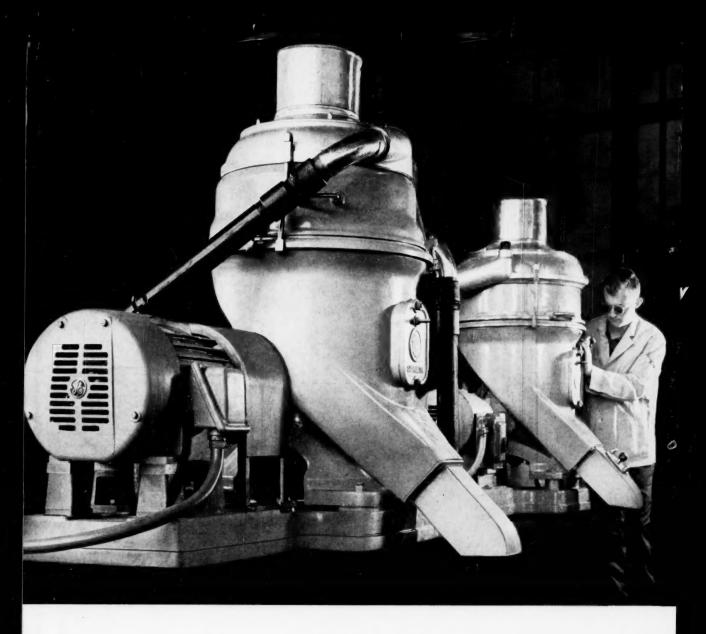
With five types of parallel and right angle Gearmotors, Master has the flexibility and choice of design you need.

With electric motor and gears combined into a compact, integral power unit, you reduce costs and increase efficiency through elimination of belts, couplings, chains, sprockets, external bearings or separate reducers.

They are available in sizes from 1/8 to 125 H.P. You can integrate with the gearmotor: electric brakes, 3 types of variable speed units and fluid drive in any combination.

THE MASTER ELECTRIC COMPANY · Dayton 1, Ohio

DIVISION OF RELIANCE ENGINEERING CO.



# Now...separate slurries up to 35% solids by volume without stopping for sludge removal!

You can run a Titan Superjector for as long as a month at full speed without a single shutdown for cleaning.

This centrifuge periodically ejects sludge *automatically* while running at full speed, cleans itself completely in ten seconds or less.

With this new Pfaudler centrifuge you can concentrate solids up to 40% dry weight. You can get clear effluents at the same time.

It discharges mixed solid particles up to 1/6" diameter, removes solids both heavier and lighter than infeed,

There are settling vanes within the Superjector to curtail turbulence and shear of solids. You can adapt infeed holes and disc spacers closely to your product by selecting from the wide range of discs available from stock.

#### Lower running cost

The Titan Superjector periodically and automatically rids itself of sludge through a series of ½" by 5" slots on the bowl circumference. The bowl's own centrifugal force builds up the hydrostatic pressure which opens the slots.

Since there is no braking effect from continuous discharge of solids, power consumption is exceptionally low.

The Titan Superjector has proved its value time and time again in such service as separating liquids from animal intestines for pharmaceuticals, refining vegetable oils, purifying waste lubricants, extracting fish oils, recovering yeast and cereal proteins, and a great number of other uses.

For further information on its unique design and operation, write for Bulletin 946.

#### THE PFAUDLER CO.

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